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MY SEVENTY-FIVE YEARS IN THE HEART OF A TURBULENT RUSSIA

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# STRAWBERRIES FROM CHERNOBYL



**EVGENY P. VELIKHOV**

# The fascinating autobiography of the great Russian scientist, Evgeny Velikhov



As a child he played in the fresh ruins of Stalingrad just weeks after that monumental battle had ended. Growing up in the Stalin and Khrushchev eras, Evgeny Velikhov's persistence, intelligence and wit propelled him to the highest levels of influence in the Soviet Union's academic and political hierarchy. As an accomplished scientist and diplomat, he has negotiated with world leaders and been a trusted advisor and confidant to every Russian president since Gorbachev.

This is a first-person account of one man's rise from the humblest of beginnings to the halls of power in one of the world's preeminent countries. At the same time it is a rare and compelling glimpse into the political and social evolution of an enigmatic and often perilous nation. Evgeny Velikhov had to tread carefully and muster all his talent and cleverness to not only survive but thrive through successive regimes, first in the often tumultuous USSR, through the breakup of the Soviet Union, and on to the modern Russian state.

As one of his nation's premier scientists, Velikhov was the person Gorbachev called when the news arrived about the nuclear accident at Chernobyl. He was gone for weeks supervising the recovery, only rarely able to contact his wife, Natalia, who was consumed with worry as the news of the accident filtered out. Then one day...

*I came home from Chernobyl without any prior warning, and my wife was already desperate and suspected the worst. I had brought with me a large basket of strawberries. She said, "You're crazy!" We measured the strawberries with a Geiger counter, and it gave a little ring. "Well, now," I said, "measure me." She measured, and there was a continuous ringing! I asked her, "Are you going to sleep with me?" She responded, "Well, what else can I do?" "Then," I said, "let's eat the strawberries."*

"A journey through the life of an extraordinary man of superlative intelligence and, at the same time, a light-heartedness and wit that makes this a most memorable reading experience. *Strawberries From Chernobyl* provides a window into the history of postwar Russia through the eyes of a true insider."

Tom Blees

President, The Science Council for Global Initiatives

# **Strawberries from Chernobyl**

*My 75 Years At The Heart of a Turbulent Russia*

By Evgeny P. Velikhov

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So many tales I know.  
I am overgrown by them, like a ship's keel is by mollusks.  
-Maksim Gorky

In my soul, like in an ocean,  
Lies the ballast of shattered hopes.  
-Mikhail Lermontov

I was born in 1935.

A hazy memory remains from when I was about three. My father was always somewhere on a construction job: he built bridges in Siberia, and then worked on DneproGES,<sup>1</sup> then in Magnitogorsk.<sup>2</sup> My mother, unfortunately, I remember only from photographs. I lived primarily with her mother, my grandma, near Losinoostrovskaya station on the Yaroslavskaya railroad, near Moscow, where my father received a separate apartment on the first floor in a two-story wooden log house. On the second floor lived engineer Rambidi with his family. His son is the one I remember. He was about three years older than me, and at the time that meant twice my age! At first our relationship was reminiscent of the relationship of N. Gumilev with the turkey in his famous poem<sup>3</sup>, but then it evolved into a friendship, one that gave me so much and one that continues over seventy years later.

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<sup>1</sup> The largest hydroelectric power station in Ukraine, located on the Dnieper River.

<sup>2</sup> All Russian names are transliterated using Google conversion.

<sup>3</sup> Russian poet N. Gumilev (1886-1921) compared his first love impression to his childhood encounter with an arrogant turkey.

Right around this time, my father left for the construction of a shipbuilding factory in Severodvinsk (then Molotovsk), where he was in charge of assembling the metal scaffolding. This is where, by the Polar circle on the White Sea, he brought my grandmother and I in the winter of 1938. As far as the eye could see stretched wooden houses covered in snow almost to the roof, with narrow trenches weaving from house to house. I remember Christmas trees with magical toys from a fairytale “pre-revolution” world and sweet condensed milk from America in large cans with small screw tops. There the polar night was accepted with everyday casualness. Today, on the seventieth anniversary of Sevmash<sup>4</sup>, I am the only surviving witness.

What was going on at the site I know from Nikolai P. Melnikov, whose father brought him in as an assistant – at that time still a young, little known engineer. In the final years of his life, we became very close during a project aimed to organize the oil and gas exploration from the sea shelf. But this is still forty years into the future from this point. For now though, there was just the construction site in a snowy wilderness, a starry black sky, and a full moon illuminating the laid-out, assembly-ready metal frames of the largest plant in the world (until, that is, the construction of the Houston factory to build the “Saturn-5” rocket).

Do I really remember this fantastical sight, or is it prompted by my imagination?

When the secretary of the Obkom<sup>5</sup> arrived with his GPU agent<sup>6</sup> to conduct an inspection and saw the

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<sup>4</sup> Sevmash, short for “North Machinery”, the name of shipyard in Molotovsk, now Severodvinsk.

<sup>5</sup> The regional committee of the Communist Party.

construction site, he recommended sending my father to a labor camp which was located nearby. The secretary did not want to wait the three months still remaining until the project's deadline, and this was rather understandable: the site lacked the key ingredient – cranes and tools for installing the steel structures of the plant. These were structures of immense magnitude – forty meters in height, hundred and fifty meters wide, and half a kilometer long! And there were no cranes capable of this task in the U.S.S.R. back then... but somehow my father convinced him to wait until the deadline to send him to the labor camp. And the steel structures were built within twenty-five days.

At the suggestion of Nikolai Melnikov, the first stage was raised using railroad sleepers as levers, and the resulting structure was used as a derrick crane to hoist up the next piece. When the finished product was delivered, the GPU agent ran around knocking on the beams with his knuckles not believing that they were indeed made of steel. Documents began to be prepared for the first Stalin Prize. When Nikolai Melnikov came to coordinate the list, father asked not to be included. It seems that he understood the workings of the system very well.

His father, my grandfather, Pavel Apollonovich Velikhov – a railroad worker and a professor – was on Lenin's "internal enemy list" as well as on the "untrustworthy list" of the Tsarist secret police. During the Tsarist times, my grandfather sat in prison once, and during Leninism, four times. Once he ended up in a psych ward,

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<sup>6</sup> GPU (1922-1923), the State Political Administration, which was preceded by the Cheka (1917-1922) and later became OGPU (1923), NKVD (1934), NKVD-NKGB (1941), MGB (1946) and KGB (1954-1991).

perhaps “out of medical and humane reasons.” Under Stalin, Pavel Velikhov was adjoined to the so-called Prompartia<sup>7</sup> and in 1930, executed.

After some time those on Nikolai Melnikov’s list began disappearing. He recalls that he came to my father for advice, this time about his own fate. Father assigned him to several (consecutive) business trips to Moscow, so for half a year he traversed back and forth across the country, waiting until either the terror abated or his case was lost.

An assembly of two battleships began at the shipyard. At the time of installment the roof of the neighboring workshop began to sink – the prisoners built a stove on it to keep warm (the labor camp was right there, at the spot). Construction was reinforced with the same rail sleepers used to build the structure. Because of the war, the battleships were never completed, but the plant was put to good use during lend-lease. Nikolai Melnikov told me an interesting story about this. After the war at the final stages of the lend-lease, he was sent to the U.S.A. to a shipbuilding plant, home to the serially produced destroyer U.S.S Liberty. He went around, looked and admired. The director (or the owner) listened, listened, and then asked, “Why are you bullshitting me? During the War, I deliberately enlisted into the Navy convoy to have a chance to tour the entire plant in Molotovsk. It’s an order of magnitude more powerful than ours.”

Later, over a hundred nuclear submarines were built at the plant. The team was nominated for the Stalin Prize. They say that at the end of his report, V.M. Molotov

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<sup>7</sup> Prompartia or Industrial Party was the Union of Engineers’ Organizations.



remarked: “Some of our people served time...” I.V. Stalin replied: “And we served time. Nothing unusual.” The survivors got the Prize.

In 1939, the epic structure in Molotovsk was successfully completed, we returned to Moscow, and father was assigned to build the steel foundation of the Palace of the Soviets.<sup>8</sup>

Now a bit about my roots. The Velikhov family comes from the clergy – from the rector of the Smolensk Cathedral. His children became engineers. The next generation – Aleksandr Velikhov – was the deputy chairman of the Society of railways and the chairman of the Society of private railways, had stock and was a homeowner. His son – Lev Aleksandrovich Velikhov, my cousin’s grandfather – became a known public figure: first he was a member of the “Emancipation of Labor” party, and then a member of the Constitutional Democratic (Cadet) Party of the State Duma and the central committee of the Cadet party, where he was responsible for municipal politics and governance. He edited numerous publications, including the magazines “Urban Matters,” and “Local Governance Matters,” and published a few of his own books. The most famous, “Theory of Urban Economy” published in 1928, still remains one of the best references in the field. His article “On the Kiev Congress of City Government Leaders” published in the newspaper “Urban

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<sup>8</sup> The Palace of the Soviets (Russian: “Dvoretz Sovetov”) was a project to construct an administrative center and a congress hall in Moscow, Russia, near the Kremlin, on the site of the demolished Cathedral of Christ the Saviour.

Matters” in 1913, is interesting in its analysis of the civil society in Russia, and received dubious fame thanks to V.I. Ulianov (Lenin) who in the heat of a polemic derided him for being a landlord.

Grandfather did not pay any attention to the criticism from Lenin, although in the spirit of vulgar Marxism one could call *him* a landlord: at that time Lenin lived on the income from his mother’s estate. Mr. Lenin’s later sources of income, as is well known, became more diversified and included resources from other sponsors as well, including the German General Staff. Besides this, his list of resources was augmented by revenues generated by the banditry of Joseph Stalin and others.

In the aforementioned article, grandfather argued that the presence of an independent stream of capital is very important to the independence of the political delegate and the political party under his leadership, otherwise the delegate would be pulled under the control of two overpowering bureaucracies – bureaucracy of officialdom or bureaucracy of public organizations. This analysis, in my view, remains relevant today as well, in Russia as well as worldwide. (Curious readers can refer to the aforementioned article itself for details of the author’s argument).

My grandfather fought in the First World War. He participated in the cavalry raids behind the German front and was a commissar in the Provisional Government. After the revolution he soon retired from political activities and focused on scientific and educational work in the field of urban construction and local administration. He lived in

Novocherkassk – the home city of M.I. Platov<sup>9</sup> and P.I. Pestel’<sup>10</sup> – under the watchful eye of the GPU and NKVD,<sup>11</sup> since he was an official enemy of the people according to the V.I. Lenin’s directive. This lasted until 1938 – the year the personnel at NKVD were replaced. At the same time, in Rostov appeared a rising star with a third-grade education – comrade V.S. Abakumov.<sup>12</sup> Because of the lack of better fodder he started “eating up” the old intelligentsia, including my grandfather. In 1938 grandfather was imprisoned, for three years he was tortured for the so-called investigation, and in 1940 he vanished in the northern prison camps. Evidence of his final moments has not yet been found in the archives of the FSB<sup>13</sup>

My direct grandfather, Pavel Apollonovich Velikhov graduated from the Institute of Railway Engineers in St. Petersburg and as a place of employment chose the newly formed similar institute in Moscow. Already a student, he participated in gatherings and protests, ending up under police surveillance. In Moscow, grandfather successfully practiced scientific, applied and pedagogical activities in the field of bridge construction – he was a great lecturer and was liked by his students. But his continuous political activities hindered his academic career. Unfortunately, this was the fate of countless talented scientists and engineers in Russia. One time he wound up in jail.

Grandfather joined the Constitutional Democratic Party, ended up in the Moscow Committee of the Party and

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<sup>9</sup> A General during the Napoleonic Wars of 1812, Cossack-born.

<sup>10</sup> An early 19<sup>th</sup> century era political reformer in Russia.

<sup>11</sup> NKVD (1934—1946) “People’s Commissariat of Internal Affairs”, later MVD, “Ministry of Internal Affairs”.

<sup>12</sup> Who later became a high-level Soviet security official with a notorious reputation for torture.

<sup>13</sup> Federal Security Service – modern manifestation of the Soviet KGB since 1991.

was elected a member of the Moscow Duma. Following this he balanced work at the Moscow Institute of Railway Engineers with instruction at the Moscow Advanced Imperial Engineering Academy, where he was elected the Vice-Chancellor of research. During the Soviet times grandfather did not dabble in politics, but he participated in public discussions of self-governance for the higher education institutes. Consequently, he was recorded in Lenin's "List of Internal Enemies" of the Soviet regime and was subjected to exile. The deadline for the exile expired, however, while he was in prison and as a result he and his family remained in Russia. Despite all the difficulties, grandfather considered the years of work in Soviet Russia to be his most productive. In 1929, as I mentioned above, he was arrested on a case with the so-called Prompartia and in 1930 he was shot.

It is best to imagine my grandfather in his private life through his personal letters. His family life was fairly unconventional – he was in the course of his life married to both my grandmothers (not at the same time, of course). Seemingly he loved them both, and they treated him well, as well as each other. Until the last hour of his life he cared about them much more than about himself. A widely educated man of high culture, representative of the Russian intelligentsia of the Silver Era, he possessed a very developed sense of dignity, honor, and obligation. He was able to transmit this to his two sons – my father, Pavel, and his brother, Evgeny.

My grandmother, the mother of my father, Vera Aleksandrovna, was from a wealthy merchant family. Early in her life she was sent to a boarding school for girls of the

noble class. Traditions there were strict. Even in her late years she would wake up in cold sweat after a dream of tomorrow's math exam. However, she was rescued by her personality: not wanting to take the exam, she undertook preventative measures – namely swallowing a fly to make her vomit. Grandmother retained her playful nature throughout her entire life. She reminisced how the merchants would pick up girls for nighttime entertainment. “Kaddish – what a joyful dance, and wild, and passionate. It was brought by the Spaniards – wonderful at love!” Her stature remained until her death, and in her older years she joked: “From behind I am ‘lead us not into temptation’; from my forefront I am ‘deliver us from evil’”.

At the time of her flourishing life under the tsars, Vera Aleksandrovna accompanied grandfather to scientific congresses in Paris and elsewhere. Grandfather, it seems, in his youth courted my other grandmother, Evgenia Aleksandrovna, but she chose a railway worker Vsevolod Aleksandrovich Evreinov – my maternal grandfather. Family lore says that grandfather Pavel had plans to spend his honeymoon in Berlin. Grandmother arrived before him, and when he came to register at the hotel he was told that Mrs. Velikhov had already registered the room with her husband. He turned out to be my grandfather's brother, who also planned to vacation with them and politely offered his room. All turned out positive for every side, but this incident was quite symbolic.

During the Civil War, grandmother Evgenia with her husband and children (my mother Natalia and her brother Dima) ended up in Ekaterinburg. There, grandfather (Vsevolod Evreinov) died. His death was not so openly

discussed in our family, it was said he died of typhoid fever. Now I think that almost certainly he was in Kolchak's<sup>14</sup> government. When grandmother Zhenia<sup>15</sup> returned home with the children, she married my grandfather (Pavel Apollonovich). That's how the family acquired two sons.

Grandmother Vera left for another young railroad worker. Unfortunately, their shared happiness did not last long: he died tragically saving a child from under a locomotive. In my memory, though, grandmother Vera never looked unhappy. She continued to live in one room in grandfather's humongous professorial apartment that was refurbished into a "Kommunalka," a communal flat.<sup>16</sup> The family of my grandfather had moved out. I spent much time in grandmother's room, where on the wall two stains were still seen from the heads of my father and uncle as they pressed against it listening to the evening's reading in bed. During the War she donated blood and received rations, including vodka – she liked to have a drink, until her death. Grandmother was very kind, and I never heard a mean word about anyone from her: not about neighbors, who essentially moved into her apartment, not about non-Christians or people of other ethnicities, which is not very usual for Russia, and so on.

Grandmother Evgenia was a completely different person. From a young age until her death (in 1952), I was practically given over to her care. This is typical for Russia, just remember the grandmothers of Lermontov and

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<sup>14</sup> Admiral A.V. Kolchak – directed the White Guard forces in Siberia during the Civil War.

<sup>15</sup> short for Evgenia.

<sup>16</sup> "Kommunalka" – after the revolution multiple families were forced to live together in big apartments, usually one family to a room and everyone shared the kitchen and the bathroom.

Pushkin. This upbringing leaves a certain imprint on one's future life, especially for a boy. Evgenia came from Baltic Germans and her personality resembled, at least to me, that of princess Olga or Catherine the Great. She told many stories and read to me not only in Russian, but also in German. Consequently, as a child, I spoke German and read not only Cyrillic but also Gothic script. It all began with Max and Moritz and the Brothers Grimm tales read in the original language. I believe that detailed familiarity with these fairy tales is irreplaceable in understanding the national German spirit. Then it was books by H. Heine and, of course, Goethe – the great atheist. Grandmother was not a believer and raised me the same way. She despised V. Lenin and M. Gorky – and not without reason suspected that they considered the Russian people as manure for the world revolution. She thought of Stalin as a grand criminal. The revolution, in grandmother's opinion, was organized by the Jews. She was not an anti-Semite though - especially with a family name like the Evreinovs.<sup>17</sup> She had her rational approach toward family life. She separated sex from love, and love from obligation, including family obligation. Before the War she had a young lover from the well-known Bartenievs family. Later, his sister, Natalia, whom we called “the sister of the lover of my grandmother,” described that after he separated from Evgenia and having known many women, he never found a worthy substitute.

Sasha Barteniev, her lover, was a big devotee of technology; he put together a three-wheeled automobile, on which we drove to the Eliseevsky store for groceries. On

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<sup>17</sup> The root of “Evreinov” in Russian is “Jew”.

the drive sometimes we would halt, and young boys would gather around. He would gently pet them on the heads. I wondered, “Why are you encouraging them?” Once he explained: “And how would I wipe my hands otherwise?” His hands were always covered in oil...

Like many friends of our family, he was “Lishenets,” one of the legally disenfranchised people;<sup>18</sup> he was not allowed to finish college. At that time I was already aware that for an intelligent person it was commonplace to spend time in the Butyrka prison,<sup>19</sup> and learned how to control my communication with strangers. Large parts of the exterior world became foreign to me, which could not have left my psyche unaffected. However, these events did not influence my patriotic feelings in the spirit of Count Aleksei Konstantinovich Tolstoy<sup>20</sup> (not to be confused with Aleksei Nikolaevich).

The last pre-war period in Moscow had begun. Mother, apparently, was already sick. I lived with grandmother, occasionally with father. I remember an excursion with him to an agricultural exhibition – the grandeur of the pavilions, remarkable models of dams, factories, all completely automated, an American-style chicken farm, wild-grown pineapples – the classic symbol from school times of bourgeoisie heaven. And fruit! Real fruit! Middle-Asian pears – those into which one melts all the way up to his ears and those that stream down onto your stomach. Crimean apples, the genuine Antonovka.<sup>21</sup> Where did it all disappear to? And not just here, but also in the

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<sup>18</sup> “Lishenets” – persons legally stripped of rights and discriminated against in the early Soviet period.

<sup>19</sup> Butyrka prison was the central transit prison in Moscow.

<sup>20</sup> Count Aleksey Konstantinovich Tolstoy (1817 – 1875) was a Russian poet, novelist and dramatist.

<sup>21</sup> A variety of apple.



entire civilized world? Grandmother was from Michurinsk and lavishly accused the neighbor-landowner of ruining all apples in Russia<sup>22</sup> by following some American, who ruined them all in America, and then pretty much everywhere.

Grandmother took me to a German kids club and was very excited about our warming relations with Germany. She made an almost fatal mistake: listed herself German in her passport – she thought to strengthen her role as a widow of two “enemies of the people.” As a result she almost ended up in Kazakhstan<sup>23</sup>. How did father manage to hide her in the family during the War? Not the slightest idea! She lived the entire war under the Sword of Damocles.

Mom died. I was told almost nothing, was not brought to the hospital and was not taken to the funeral. She was like a fairy from an imaginary world. Father introduced me to her friend, Vera Nikolaevna Zagorianskaia. The brother of Vera (uncle Boba) was from father’s circle; when mother was still alive we would visit with him outside of Moscow. In his time, the father of Zagorianski was the General-Governor of Riazan. And through their maternal lineage they were from the well-known Moscow businessmen, the Levenshteins. Even today, the tallest headstone at the German graveyard is their obelisk. Grandmother recounted later how Vera promised my

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<sup>22</sup> Reference to Ivan Vladimirovich Michurin (October 1855 – 1935), Russian practitioner of plant selection.

<sup>23</sup> Kazakhstan was the site of mass political exile.

mother to take over my care. I think that the romance between my father and Vera had a long history, and grandmother accepted the newly formed family configuration as an inevitable reality. This remained for the next ten years until the deaths in 1952 of first my father, and then my grandmother. Vera was a highly energetic, well-meaning and caring woman from that same old circle of Russian intelligentsia. Effectively she replaced my mother since she adored me and I loved her. Of course, there was my grandmother too, but she could hardly interfere. And she did not.

Until very recently I had not dug deep into my own soul. Yet as part of remembering, this is inevitable. It seems to me that my psyche has an aberration that, for the most part, determined the path my life took. This may be pathology, may be genetics, may be environmental influence, or may be all of the above. But inside my soft, kind, and flexible shell lays a hard nucleus capable of a powerful repellant force. It cannot be controlled by the mind, but itself controls both the mind and the emotions. I did not know mom nearly at all, but the signals by Vera did not reach my depth, and she always remained Aunt Vera. And neither did the signals from any other woman in the future; only from my inside outwards. I never read one book upon someone's recommendation, even if it sounded reasonable. Father persistently recommended *David Copperfield*. I read nearly everything by Dickens, but never *David*. I read the *Mahabharata* end to end, but never the Bible or the Gospel, nor *Das Kapital* or other volumes by the classical Marxist-Leninists, with the exception of *The*

*Brief History*,<sup>24</sup> but this only serves to further the point. This wasn't from any rational considerations; I just could not overcome my internal objections. I did not make use of any advice from friends or supervisors in my scientific career. All my life I have eaten breakfasts that I cooked myself. I transferred from the Kurchatov Institute to a village near Krasnaya Pakhra (now Troitsk) at the first opportunity and returned to the Institute, as elected President, during the period when our democracy stood on its head. When the craze was over, I negotiated with B.N. Yeltsin and took the Institute from the control of political ministries and departments. I can say with an honest conscience: "Thank You, Lord, that You created me a non-believer." I was simply unable to craft idols, even one out of myself.

My father was given three bedrooms in a new but communal apartment on the Frunzenskaya Embankment. We got ready to move in, but the war started. Father was already in the group under Dmitrii Fedorovich Ustinov<sup>25</sup>, and early in September we set out for Ural region to build new factories. In the boxcar I was always afraid that parents would be left behind at some station. We arrived in Perm and at first we lived on the outskirts in a barracks. Some of my strongest memories relate to an intimate relationship with death. Next door to us was a morgue. Creeping up to the pile of the deceased and pulling out the bottom one was a favorite pastime for children at the time.

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<sup>24</sup> *Brief History of the Communist Party of the U.S.S.R.*

<sup>25</sup> Later defense minister of the U.S.S.R.

Nearby, living dead wandered around – people from the labor army.<sup>26</sup>

From the more cultural memories, I remember how father read out loud in the evenings under a kerosene light. I remember “The Masquerade” by M. Yu. Lermontov; “The Two Dianas” and other novels by A. Dumas; “The Silver Prince,” “Stream-Hercules” and other poems and novels by the Count A.K. Tolstoy (Tolstoy’s book was of a pre-Revolution edition, and therefore not very “legal”). We had literary anthologies available for the entire high school curriculum, and I read with huge pleasure and interest the bylinas,<sup>27</sup> poetry and prose of A.S. Pushkin, M. Yu. Lermontov, I.S. Nikitin, N.A. Nekrasov, N.V. Gogol and other Russian classical authors. Subsequent required reading in high school never evoked as much genuine and novel enjoyment. We lived in cold and hunger; I remember some kind of porridge with mouse shit in it. But once in a while, the heroic Aunt Vera would embark on a journey across villages, exchanging the remnants of past luxury for stunning foods: a piglet, baked milk, honey, or eggs. Father and I desperately worried over her trips, he was also frequently ill. The cold that winter was fierce. Through the cracks between logs we could see the stars, yet we survived.

We traveled around the Urals following my father’s assignments. In Chelyabinsk we lived in a nice log house. There, by chance, we united with his brother. The Maly

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<sup>26</sup> The notion of the Labor army was introduced in Soviet Russia during the 1920s. Initially the term was applied to regiments of the Red Army transferred from military activity to labor activity, such as logging, coal mining, etc.

<sup>27</sup> Russian folk epics (known as “bylina” in English).

Theater<sup>28</sup> was evacuated to Chelyabinsk. I went to see many plays with pleasure. We planted potatoes in the summer, and then harvested them in the fall and stored them in a dugout cellar. This way we were set for the winter. (By the way, I still grow potatoes.) I found many old magazines in the attic of the log house: “Niva,” “Ogonek,” “Technique for Youth,” and others. Those magazines were regularly seized from the libraries to cover up history, and the attic contained some magazines from before the Revolution. From these magazines I learned lots of interesting tidbits. For some reason in the thirties there were active discussions of chemical and biological warfare, Freemasonry, encephalitis, and wireless transmission of energy for transportation. There was lots of science fiction: *War of the Worlds*, *The Time Machine*, *The Lost World*, and others.

Overall I am a Moscovite. I do not spend extended leisure time further outside of Moscow than Preslavl-Zalesskiy. I normally don't vacation at resorts and have no plans to do so. But in my life there were four epochs that left indelible imprints: Severodvinsk (Molotovsk), Stalingrad, Chernobyl, and La Jolla (U.S.A.), where although I did not live there, I was the Chairman of the Board of Directors of the international thermonuclear experimental reactor project (ITER).

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<sup>28</sup> Maly Theatre, literally Small Theatre as opposed to nearby Bolshoi, or Grand, opera theater, is a drama theater in Moscow.

At the end of February in 1943, immediately after the Battle of Stalingrad, father was sent to work on the construction of Stalingrad factories (“The Barricades” and tractor plant) and blast furnaces in Ukraine. We were put up not in a building, but rather in a half-building – one of the walls was a tent. A young boy who lost his entire family in a bombing also lived with us.

For a boy of eight, Stalingrad was a shock and a revelation. One could not have thought of a better playground. My first impressions came as we drove through weaving, narrow veins of streets, both sides overflowing with smashed ruins of European technological miracles: tanks, cannons, trench mortars and automobiles, and behind them snow, and empty boxes of apartment buildings with stairway landings. When the car rode by this “dead” technology, it felt almost more alive. Memory recalls also Mercedes-Benzes with the easily recognizable emblems, but without batteries – they had to be dragged to a hill and then rolled down to start the engine. But the solid German craftsmanship never disappointed.

I met the boys next door, started to acclimatize to the new site. At first we had easy access to any weapon, but then they were taken away, leaving only breech-loading mechanisms and ammunition for every taste. The bullets were of little interest to us, since they propelled slowly and inaccurately. But in the artillery cartridges one could find gunpowder and throw a few thin disks of it into the outside stove on which grandma Vera cooked. The flames would shoot up into the sky, but, luckily, there was no damage. This was one of our favorite pastimes! Losses among the

youth were light, from our group only one blew himself up at the Mamayev hill<sup>29</sup>.

Skeletons were lying in the Volga River. The oil storage tanks were still burning. We would dig through the ruins of the school, take out documents from the pockets of dead soldiers and give them to our teacher. Of the extraordinary treasures I remember a magnificent bayonet-dagger in a sheath, still greased-up, and flashlights with springy hangers, sapper shovels and metal crosses. For the first time, we got to see an aluminum folding bed and a gas canister, whose design still sets a high bar for innovation. Once in a while it was possible to unravel a “bomb” of provisions with German rations. We would wonder: with a life like that, why would Germans try to invade us? After the hungry years in the Urals this was a luxurious life: with American canned beef, egg powder and sweet condensed milk. In the summer watermelons appeared from Volga, then apples and Greek melons. All of it was just spread out on the ground: eat all you like.

When the school was rebuilt, we would run over to keep warm, make our way over to the stove and fall asleep. At that time I quickly memorized the multiplication table and could do mental calculations very well, even better than the teachers, so they didn't bother me much. Later, when calculators became available, I never got used to them – before you have to get it out, open it, press the correct buttons, you already know the answer. An

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<sup>29</sup> Mamayev hill, “Mamayev Kurgan” – a place of the most fierce fighting in Stalingrad.

important realization from this technology was the awareness of the ills of over-precision. Ability to perform calculations in one's mind and acquiring mastership over one's internal language are the most crucial elements of our development, in my opinion.

From his trips to factories father brought back books. That's how we had Jules Verne, Mark Twain, Thomas Mayne Reid, James Fenimore Cooper, and our science-fiction writers. Father gave me a wonderful trilogy by G. Senkevich: *By Fire and Sword*, *The Flood*, *Mr. Volodyevskii*, and then *Quo Vadis?*. Although I knew, of course, *The Captain's Daughter*<sup>30</sup>, and *Taras Bulba*<sup>31</sup>, my soul was really united with Pan Zagloboi, Podbipentoi, Lieutenant Volodyevskii<sup>32</sup>, the young prince and Rzeczpospolita. Later in Moscow this led to serious confrontations with my history teacher, who was simultaneously the principle of the school, but more about that later. Father loved A. Mitskevich, and I have well memorized the poem "Konrad Vallenrod," which clarified something for me later during Perestroika. The era in Stalingrad ended with a loss of my good health, and the related diseases that followed contributed to my self-education.

My brother Vova was born in Stalingrad. Aunt Vera had ridden over to the tractor factory to unload canned goods. She came back and announced that, it seems, it's time to give birth. Grandmother Vera told her "Ah, You, Verochka, Pavlik is not yet here, wait a little!" Father was

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<sup>30</sup> A famous novel by Aleksandr Pushkin.

<sup>31</sup> A famous novel by Nikolai Gogol.

<sup>32</sup> Characters from Senkevich's books.



in Moscow at the time. But it could not wait. The birth happened at home. The first cry of the infant rang out and, as it seemed to me, never stopped. They said “It’s healthy, lets him exercise his lungs.” I could completely understand this wisdom only when I had my own children. Then they showed us Vova. To my eye he looked pretty unsightly...

Of course giving birth in Stalingrad was a fairly risky decision, but all in all, with the exception of a few difficulties, everything turned out well.

In the spring of 1944 we returned to Moscow – first I came back, then the others. I remember being near the zoo with grandma Zhenia. Posters everywhere, advertising the Allies and the second front. Right there at the corner, Grandma took me to the barbershop and said “Here we will leave all your lice behind.” The barber proceeded to shave my head. After that, for many decades, I walked out of my way to avoid that place...

The following episode comes to mind. My fun-loving grandma Vera and I came to visit the young wife of my uncle. They lived in the building of the Maly Theater then. Grandma brought a bottle of French Champagne, a war trophy from Stalingrad, and the three of us, as we were supposed to, finished it all. It was probably the first time that I was slightly drunk, and it was a lot of fun. That’s how the tight-knit relationship between my aunt Lera (who was 22!) and me was established, which continues to this day.

In the fall I entered the fourth grade. The principle was a lady of the Stalinist persuasion, and she taught history.

Since childhood I have been writing half-plagiarized poems, including, in this case:

Surrounding us, a light shines bright  
And distant nations are lit up,  
Only our school's without light,  
And here, a tyrant's at the top.  
But do believe, she'll rise again... <sup>33</sup>

And so on, according to the text. Somehow, I got away with this. The atmosphere in the classroom was not easy. Usually, underneath the back desk, the cool kids played rounds of cards, and one guy engaged in masturbation on a regular basis. During line-up the local hooligans would burst into the school courtyard and beat up everyone around, including the teachers. One time they tried to blow up the school; the building cracked but stood. The gym teacher concurrently taught drafting and demonstrated wit “There is a violinist named Oistrakh, but your drafting is Oi-so-terrible.”<sup>34</sup> He beat us and as punishment forced us to crawl around the gymnasium on all fours. In chorus we sang “Artillerymen, Stalin gave the command...”<sup>35</sup> Yet we still learned something.

At that time I was mostly interested in adventures and history. I developed a habit of trying to learn each lesson better than the teachers, which was not that difficult, given that there were good books at home. Besides, there was

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<sup>33</sup> Based on liberal lyrics by A. Pushkin. Translation by Andrey Kneller.

<sup>34</sup> In Russian, the last name of the violinist David Oistrakh is composed of the exclamation “Aye” or Oi and the Russian word for “fear.” The gym teacher used this play on words to replace “fear” with the Russian word for “terrible.”

<sup>35</sup> This was the marching song of Stalinist artillerymen.

another supporting factor. One of Aunt Vera's close childhood friends, Rika, married an Italian professional diplomat, Petronia Kvarelli. After Mussolini's overthrow in 1944, he was sent to Moscow as the ambassador. During the summers, my family rented a dacha in the Kraskovo village where they would visit with their children. We hung out a lot, and Uncle Petronia talked about ancient history in colorful and knowledgeable terms. He had fake teeth attached by little springs, and he loved to play with them: to pull them out and let them pop back in, demonstrating the marvels of western technologies. He also supplied me with Italian-made tin toy soldiers. I read the history of the art of war, including the Napoleonic campaigns. Under his influence, I started reading Plutarch. On this basis of our mutual interest in toy soldiers and playing war, I became friends with the neighborhood boy Serezha Shcherbakov, who lived in Moscow in the "House on the Embankment,"<sup>36</sup> with which this was my first encounter. We are in touch to this day; Serezha Shcherbakov is now an academician<sup>37</sup> in biology.

At home my main duty was to take care of Vovka. In the morning, as soon as he popped out into the street, he would run to the nearest elderberry bush and eat the berries up with both hands. Aunt Vera would tell me "Go see what Vovka is doing and tell him to stop." I witnessed this type of focused spitefulness displayed by Vovka (he knew he wasn't supposed to eat the berries, which could make him sick) only one other time, in Yakov Borisovich – a monkey

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<sup>36</sup> The House on the Embankment is a block-wide apartment house in downtown Moscow, built in 1931 as the Government Building, a residence of Soviet elites.

<sup>37</sup> Academicians in the Soviet Union were members of the Soviet Academy of Sciences.

that lived with our family for several years. But this story will have to wait for later.

In sixth and seventh grades my interests shifted toward physics. My father brought home James Jeans' *The Universe Around Us*, published in the U.S.S.R. in 1932. With plain words the book describes the entire creation of the Universe – from the atom to the stars, galaxies, and the universe as a whole. I developed a liking for physics class and became friends with two boys there – Dima Vaintsvaig and Goga Popko. We remained friends all our lives. In those days, Vaintsvaig had an impressive talent for experimentation. Only later did he replace experimentation with theory. We went together to kids' science clubs and physics classes. The physics teacher was an old lady from southern Russia, intrigued her entire life by the belt-regulated power transmission at the factory in her beloved hometown. Dima and I would try to revive the dusty equipment stowed away in classroom cabinets, and the physics teacher would defend it with her body. On the other hand, Goga's father, who was an engineer, assembled a television set right in their house! His political inclinations were quite radical. Dima's parents, on the other hand, worked at some academic institution, had affiliation with the Comintern<sup>38</sup> in the past and deeply believed in the superiority of socialism. I debated with them on those points, although politics concerned us little at the time.

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<sup>38</sup> The Communist International, abbreviated as Comintern, also known as the Third International, (1919–1943) was an international communist organization founded in Moscow in March 1919.

The event that, effectively, determined the course of my entire future life happened during a vacation in Velednikovo village, where we spent summers. With me was an acquaintance that was connected to our group only peripherally. We heard a local legend about a brother who married his sister. During their trip home from the church a big rock fell on them. Our search for the mysterious rock was rewarded by success. After deciding that it was a meteorite we broke off a little piece and on Grandma's advice sent it to E.L. Krinov at the Academy of Sciences committee on meteorites. While we were waiting for the response, it turned out that some guy with a box was spotted bumming around the woods. We suspected a competitor right away and went to figure it out. The guy turned out to be an artist, and the box was an easel. This encounter brought another life-long friendship: with Zhenia Yurgenson and his easel, I walked by foot and hitchhiked across a substantial portion of Russia.

Then the answer from Mr. E.L. Krinov arrived. He thanked us for our curiosity and informed us that the rock was simply sandstone. I did not believe him and started looking for ways to prove him wrong. That's how the chain of events unfolded: rock – composition – spectral analysis – spectroscopy – theory of the Bohr atom. I needed calculus. I learned on my own limits and derivatives, and my father helped with integration. A vivid memory remains of the first definite integral conquered, and then of Maxwell's equations. For this my father took me to a friend of my grandfather's – a member-correspondent of the National Academy of Sciences, Torichan Pavlovich Kravets, who lived in Leningrad. Memories of the city, the

palaces, the Nevskii Prospekt, the Peterhof palace, café “Nord” and coffee with cream remained with me for life. Torichan Pavlovich was a true representative of the Great Russian Intelligentsia in all its glory. It is possible that I am mistaken or that childhood memories become exaggerated, but it seems to me that I have never met anyone better educated or more intelligent in the world. He also ended up on Lenin’s “List of Internal Enemies” and was about to be subjected to exile out of Russia, but that did not happen since Torichan Pavlovich was already sent into exile to Siberia. His method for Maxwell’s equations I continue to use throughout my life.

My friendship with Zhenia, the artist, also led to other significant consequences. Still in Velednikovo, he brought me to the house of Zinaida Vasilyevna Ershova. She was a very “secret” woman – she was called the Russian Marie Curie. In fact, she did work in Paris at the laboratory run by Marie Curie, and later Igor Vasilyevich Kurchatov<sup>39</sup> enticed her back with the nuclear problem. She received the first samples of the metallic uranium, plutonium, and polonium used for developing a neutron-fused bomb and became one of the founders of the famous A.A. Bochvar Institute for Inorganic Materials. Despite the differences in position and age, we enjoyed friendly warm relations for my entire life. Later, when I was appointed to be the director of the thermonuclear program, Zinaida Vasilyevna led the effort to develop tritium as thermonuclear fuel. Among her many talents and positive personality traits,

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<sup>39</sup> Academician Igor Vasilyevich Kurchatov (1903 – 1960) was a Soviet nuclear physicist. Under his direction, the Soviet Union successfully tested its first plutonium-based nuclear device in 1949. For this reason he is remembered as "The Father of the Soviet Atomic Bomb." The Kurchatov Institute, Russia's leading research and development institution in the field of nuclear energy, is named after him.

right away I was impressed by the strong sense of duty and responsibility that she possessed – qualities that, it seems, were much more typical of her, and unfortunately not my, generation.

The nuclear problem was kept totally classified; on the other hand, there was quite a lot of literature on the topic. Already in 1945, Nikolai Rambidi gave me the report written by G.D. Smith on the Manhattan project in the U.S.A. I remember a wonderful book by Hans Bethe titled *Elementary Nuclear Theory*, and a textbook by Henry DeWolf Smyth, *Introduction to Nuclear Physics*, where I found a clear explanation of the principles of quantum physics and the theory of relativity. In 1948, I read a collection on quantum electrodynamics with an essay on the Lamb shift and a wonderful essay by Victor Weisskopf detailing the polarization of a vacuum. I did not think then that later we would become great friends (at least from my side—he, unfortunately, is long gone). In the press there were descriptions of the atom bomb experiments in America. It seemed that the time to choose a field was ripe.

About this time, a quite symbolic incident happened in Velednikovo. Aunt Vera sent me from one end of the village to the other to get Vovka. There, it was explained to me that in the bushes the girl with a limp was teaching him “love” (obviously, a more direct word was used). Vovka was around five and she was around eight. I did, in fact, find them in the bushes; I gave her a smack on the behind, grabbed him by the collar and dragged him home. The whole long way home he swore me up and down with the lowest words and yelled at the top of his lungs “I want to f..k! I want to f..k!” Imagine my position: I am courting a

nice young lady from an upstanding family, thinking how I could dare to hug her, kiss her, and this brat is yelling this smut across the entire village!

This story has a deeper significance. During Lenin's era, sex was discussed freely, and the theory and practice of open relationships was supported within the context of battling bourgeoisie morality. But in the 40s, the situation in society and in school radically changed. Sex became taboo along with Trotskyism, Morganism-Weismannism,<sup>40</sup> religion, and other bourgeoisie perversions. Education became fragmented. The culture of the new intelligentsia accepted this turn as a party directive, and the old did not protest much since they did not endorse the excesses of early communism anyhow. There appeared an exemplar of a party family and a code for communist behavior. Proper families did not make use of abnormal vocabulary, and neither did the media channels. But ordinary people remained the same! Under the conditions of the housing crisis, especially in small huts, the children on the polats<sup>41</sup> got their basic sexual education visually, based on their parents, and swearing remained the primary method of expressing emotions both in private life and at work. The people were much more lax in their discussions of sex and politics. By the way, the authorities also freely used swear words in their administrative dealings, which contributed its own share to the erosion of public morals and public hypocrisy.

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<sup>40</sup> Biological theories of German naturalist Weismann (jointly with works by Mendel and Morgan) were discreditably stamped by the Soviet ideology in 1948 as "Mendelism-Morganism-Weismannism is a prostitute of imperialism."

<sup>41</sup> Benches situated on top of traditional brick stoves built in typical Russian huts.



Another life-long memory and bond is connected to Velednikovo – with the Skriabiny family. Peregrinating through Russia with Zhenia – him with his easel, me with a book – we decided to visit the monastery in Zvenigorod. The teacher with whom he was taking French language lessons knew the family of the academician K. Skriabin and wrote him a recommendation letter. Zhenia, a person with an adventurous inclination, without difficulties (after all he was an artist!) or a guilty conscience edited the duration of our visit from “about two hours” to “about two days.” As a result, we spent two days living with the academician’s family. This did not solicit an especially jovial reaction from the owners, but since they were educated people they did not let it show. I met Georgii, the son of the academician. He had his own problems – during his diploma practicum he accidentally caused the death of a research cow and his father had to smooth over the consequences. I worked with Georgii later at the Presidium of the Soviet Academy of Sciences when he was the Chief Scientific Secretary, and now I am working with an academician of their third generation – with his son Konstantin at the Kurchatov Institute in my department of the Russian Academy of Sciences, where he is leading the effort on decoding the human genome and on personalized medicine. Zhenia and I walked to Zvenigorod barefoot and spent most of the time roaming the ruins of the wrecked monastery.

Grandma Zhenia<sup>42</sup> connected our family to theater. In her youth, she had her own touring theater, where famous actors performed, including A.I. Yuzhin. Her partners were so talented that once, when she was playing a bride on whose face all the virtues had to be shown except the ability to think, she could not hide her laughter and burst out at the most inopportune moment. What an affront! Eventually the theater went broke, but she got acquainted with the theater circle and married Vsevolod Grigorievich Evreinov. He was a railway engineer himself, but his brother Nikolai Nikolaevich Evreinov was one of the most famous figures in culture and theater during the Silver Era. He also ended up on Lenin's "List of Internal Enemies" and found himself in France in 1925. Incidentally, before the revolution, grandmother of Svetlana Alliluyeva<sup>43</sup> lived in his family as a governess, which is warmly recalled by Svetlana in her letters to a friend. The Evreinovs called her with them to Paris, but she chose Stalin's family. These ties helped my grandma to steer my uncle (father's brother) Evgeny Pavlovich Velikhov toward theater. The Velikhov family did not completely approve his choice. His mother, grandma Vera, lamented "One of my sons is an engineer, and the other – ah, an actor." But uncle Zhenia became a famous actor at the Maly Theater and created such memorable characters as Colonel Pickering in "Pygmalion," and Lord Bolingbroke in "A Glass of Water" (this one gave me many tips at dealing with supervisors).

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<sup>42</sup> Zhenia in Russian could be male (short of Evgeny) or female (short of Evgenia) name.

<sup>43</sup> Svetlana Alliluyeva born February 28, 1926 in Moscow, Soviet Union, later known as Lana Peters, is the youngest child and only daughter of Joseph Stalin and Nadezhda Alliluyeva.

My uncle was married to a very lovely woman – Tania Karnovich; they had a son who died. My uncle began to have an affair with E.N. Gogoleva, and he separated from Tania. Tania remained our friend and took me under her wing. She took me to almost all the plays at the Maly Theater, and later with her help and with the help of another friendly family – the Korsh (from Korsh Theater<sup>44</sup>), I got a place in the children’s group at the Moscow Theater for the Young Spectator. On top of this, my other aunt (the niece of grandma Zhenia) arranged to enroll me into a children’s theater troupe run by the MSU,<sup>45</sup> where I got a role in the play “Cinderella.” I played the town crier dressed in aunt Vera’s stockings and hat. To this day can I remember my lines “Residents of the magical kingdom, oh, residents of the magical kingdom!” The performance was a success and we even toured with it. Grandma Zhenia had a rather different view of my relationship with Tania, but, as I already explained, because of a few defects in my psyche nothing came out of it.

Love for theater was accompanied by another family tradition – playing charades. Before the revolution, well-educated families would put together home plays. No one could afford this anymore after the revolution, but the pull towards a theater life, “the instinct of conversion, the instinct to contrast images that are presented outwardly and that are freely created by men, the instinct to transform the appearance of nature” (N.N. Evreinov) was very alive and found its outlets, including in charades. The decorations

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<sup>44</sup> Korsh Theater was established in 1882 by entrepreneur F.A. Korsh (1852 - 1923). This was the first successful private theater after the repeal of the government's monopoly on theaters in the two capitals, Moscow and St. Petersburg.

<sup>45</sup> The Moscow State University.

were put together from all available material, the costumes were found in grandmother's closet, and the participants in the performances invested their talents also as directors, producers and actors. In my future career, I could use this experience in performances for political, scientific and other purposes. It is now a lucrative business, but not my calling anymore.

My education at the 49<sup>th</sup> junior high school ended, and time came to choose the next one. There were offers to arrange for me to attend the elite 110<sup>th</sup> school, but I chose 588<sup>th</sup> because the extraordinary physics teacher, Lev Dmitrievich Dmitriev, taught there. He did not know physics all that well since he did not have a university degree, but he did have experience as a laboratory assistant at a scientific institute. Lev Dmitrievich organized a top-notch physics laboratory – a workshop with rows of machines, including lathes and a radio shop. I immediately joined the physics club with my friend Dima Vaintsvaig and started to practically live there. This was a wonderful school for experiments! Amateur hobbyists from upper grades also busied themselves there. I'll list just a few of our homemade gadgets – the ones I remember. Someone fashioned a Van de Graaff generator out of the globe. It gave off a pretty respectable spark – much better than the standard Wimshurst machine that was also there. There was a working replica of an eye constructed from three condoms and plexiglas. We did not have a thermal imager, but we used a bolometer to count every person entering and to send a signal to an extremely sensitive mirror

galvanometer (this was Dima's realm!). The workshop also contained a Ruhmkorff coil that fed a Hertz's vibrator. All of this nearly came to a tragic end at one point. I was sitting at the top of the ladder and was tuning the vibrator. One wire was hanging loose. The school district inspector came in just at that moment – a bald elderly man – and paused squarely under the wire. Because of the high voltage and high frequency, a spark stung him right in the bald spot. Luckily, nothing bad happened to him and we were able to escape any potential trouble. Someone in the group also set up a cloud chamber. There was no ethanol in the lab, so we went to the chemistry teacher to get some. He said “I don't have any ethanol!” But we knew perfectly well that he did – after all, he was an alcoholic. In anger, I said “Why don't you just exhale!” The school called my parents, but all turned out fine.

There was also a “talking” electric arc built, among many other devices. Finally – my proudest achievement – I built a cathode-ray oscilloscope! At that time (in 1948), they practically did not exist in Russian laboratories at all. I snuck a peek at the blueprint during a physics practicum run by the physics department of Moscow University, where my aunt Ira from MSU managed to get me in. I found the description of the apparatus in the book by the American author P. Smith, *Devices in Physics*, that was just published in Russia. But the most important component – the cathode ray tube with an anode voltage of 300 volts – I bought at the Koptevskii flea market. The low voltage allowed me to create a simple source of energy from doubling the voltage of the outlet. The tube was German-made. I have never seen such tubes since then. Later, after

many years at the Kurchatov Institute, our veterans reminisced that in those years they had uranium readily available, but the electric circuits had to be bought with your own money at the same flea market. I remember the wonder at the first sinusoid and Lissajous figures on the greenish screen!

Physics gradually supplanted theater. I went to lectures at MSU in the chemistry department with Kolia Rambidi, and attended lectures on nuclear physics. At the Polytechnical lecture hall<sup>46</sup> – unlike now – lectures were of high quality. There was also a good club for younger students. Somehow there was enough time for everything.

To be accepted into the physics department, I had to graduate with a gold medal<sup>47</sup>, especially since I had questionable family roots and an inborn awkwardness with grammar. Knowing this, I established a wonderful personal relationship with the literature teacher, and she corrected the errors in my final paper. I will tell later how I managed this.

When I was in seventh grade, my grandma explained to me that I would have to take care of my own monetary well-being. I started tutoring, and by the end of high school had a well-established network and a sizable income. It was enough for my personal expenses, primarily spent on books. Jokingly, I refer to this period as the only brief time when I had my own money. Later, when I started a family...

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<sup>46</sup> The Grand Auditorium of the State Polytechnical Museum was the main public lecture hall of Moscow.

<sup>47</sup> Highest ranking for high school graduates.

Now we began spending summers at a dacha on the Oka River near the Sokolova Pustyn' (monastery) close to the city of Kashira. Usually we would rent a hut and bring the bare minimum and simple furniture. From there, Zhenia Yurgenson and I started going on excursions along the Oka River; from Kashira, through Serpukhov and Polenovo, all the way to Tarusa. He had his easel; I had my book on physics. Usually, on the road, he would sing arias and romances, and I would howl along with my complete absence of musical sense. Why did he tolerate this perversion? I can't imagine! We slept under bushes on the shore – just like it was proper for travelers to do in old Russia. Although one time, we got lucky. One of my relatives who worked at a museum in Polenovo for the summer took us in. Memories of those times remain forever: Oka River, the expanse, the evenings, watercolors and dioramas of Palestine by V. Polenov, his magnificent canvases and those of V. Vasnetsov<sup>48</sup>. So when I ended up in Israel many years later, I was already prepared to take in the wonders of the cradle of civilization.

There was an incident at the Oka that I still think of as slightly surreal. The four of us – Zhenia, my brother Vovka (who was about five), our friend L'vov of a princely family (his relative, also L'vov, was the premier of the Provisional Government) and I, all started down the Oka in a small flat-bottom boat. We rowed against the current and anchored in the middle of the river. Zhenia got ready to craft his landscapes – set up his easel, brushes and paints, and I got up and started contemplating how to dive off the boat. Zhenia didn't appreciate my hesitancy and pushed me off,

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<sup>48</sup> Vasily Polenov (1844-1927), Viktor Vasnetsov (1848 - 1926) - Russian artists.

and I, with my characteristic “grace”, fell first on the edge of the boat and then into the river. When I emerged from the water, I saw a terrible picture: the boat was slowly sinking toward the bottom – the edges were already submerged and Zhenia and our precious “prince” were flailing helplessly nearby. Neither could swim, but the prince grabbed the oars. Vovka was standing in the middle of the boat and was yelling out the dirtiest swears. I swam over and offered him my back. He threw himself on top of it and tightly wrapped his hands around my neck with a suffocating grip. I swam toward the shore only with the air already in my lungs. The river was wide and the current strong. As I was swimming I realized that this was it, the end. I have no recollection of how I made it to the shore with him. I dropped him off and he was still screaming with all his might “Mommy, I never want to go with them again!” I smacked him to get him to stop yelling and swam back to the boat. It was still buoyant and Zhenia was holding on to the rim. I towed him to the shore; the prince already made it there with the oars. We flipped over the boat, I recovered the easel, the brushes and our clothes, we dried out, and Vovka did not tell on us to the parents. But for many years in my dreams, I watched, as from the other side already, as Vovka and I drowned.

At the Sokolova Pustyn’, I developed many lasting friendships. One of them was with the family Chistiakov. Zhenia, as usual, actively started dating one of the two daughters, but my attempts to follow his lead were hollow. At one point, he made a castling move from one sister to the other, and their romance blossomed in a serious way. Now he is married to her and they have a son.



The following year, two guys invited the Chistiakov girls to a backpacking trip in the Caucasus. We wanted to come along but ran into a financial problem that Zhenia resolved beautifully. Somewhere he found a postcard with poppies from the Flemish art period. He prepared the canvasses, drew the outline and applied the base color, and handed it over to me for the final finish. There was a massive organizational undertaking to furnish an enormous number of Flemish poppies and to market them afterwards. It could be that they are still hanging on someone's wall. We needed money only for the resort vouchers, tickets, and food. As soon as we made enough money, we left for the trip.

I am trying to recall what we were wearing. At that time, this question did not concern us at all. I remember that during the war we would soak off emery paper with a cloth base and sew with that. In 1943, we sometimes used old donated American clothes; other times we refurbished the remnants of previous wealth or we utilized the trophies from Stalingrad. Valenki<sup>49</sup> had to be constantly patched up, but the heels were still full of holes. I wore overalls fashioned out of telogreika<sup>50</sup> and cotton pants, which is why my nickname became "Overalls" (in Russian - "Combineson"), but later transitioned to "Robinson." We even wore valenki to the Bolshoi Theater. They would let us in to the cheap balcony seats, but never to the better ones below. I still don't quite understand why a necktie is required. Many years later, when I realized that I could be appointed the President of the National Academy of

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<sup>49</sup> Valenki (Russian: валенки; sg valenok) are traditional Russian winter footwear, essentially felt boots.

<sup>50</sup> Padded cotton winter jackets ubiquitous during Soviet times.

Sciences, Aleksander Nikolaevich Yakovlev informed me – at the time he was a member of the Politburo and the Secretary of the Central Committee<sup>51</sup>, dealing with ideology, information and culture – that they preferred G.I. Marchuk because his appearance was more suitable. Looking back, it seems quite possible...

The issue of clothes became more problematic when we were already in the Caucasus, hurrying to make it down to the base in the dark, so part of the descent we slid down on our butts. At the bottom, we discovered that we looked pretty much like Vladimir Ilyich Lenin did after the explosion at the Finlyandsky Rail Terminal<sup>52</sup>. There were no extra pairs of pants, so we had to patch up the old ones.

We went on the first trips out of the famous resort, Teberda. “Teberda, Teberda, River with clear waters...<sup>53</sup>” Here for the first time I saw the Caucasus mountains. Like any first experience this one was unforgettable. I developed a longing for mountains, and, overall, in the course of the next half century, I traveled to nearly every mountain range on the planet. Mountainous rivers and lakes, wonderful forests... Our girls kept causing us trouble since they attracted other men besides the already extant competitors. The guys from Moscow faded fairly quickly, but new ones entered the field. One of the adult tourists, a “professor” from Leningrad, Zhenia and I handled fairly meanly. In the mornings, for some reason, there was always soup, so we threw in a few laxative pills into his plate. During the

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<sup>51</sup> The Central Committee of the Communist Party of the Soviet Union, the highest government body in the U.S.S.R.

<sup>52</sup> Reference to “terrorist” explosion at the Finlyandsky Rail Terminal on Apr 1, 2009 when Lenin statue got its ass blown off by a hand grenade.

<sup>53</sup> This is an excerpt from a famous song by a Russian bard Yurii Vizbor.

ascent he began to excuse himself, and at the top he lost his entire semblance of seriousness. Dealing with the instructors was more difficult, especially considering their Georgian roots. But they also enjoyed a larger selection of women, so mean tricks could be avoided.

From Teberda, we set out to walk across the Klukhorskii Pass. Climbing to the top, we enjoyed drinking the ice-cold water from the mountain stream. As we reached the top, we saw the mountain lake that was its source. At that point where the stream left the lake there laid a swollen horse carcass...

Everything was new to us – the glacier, the firm snow. During the ascent to the Sukhumi, we walked along an emerald valley, eating every fruit in sight; for this we paid a price later. Finally, for the first time in our lives, we saw the sea! From our time in Sukhumi, only two memories remain – the sea and a small basement store where you could buy authentic Khvanchkara<sup>54</sup> in one-liter bottles without any labels and sealed with wax. Later in Moscow, we also had authentic Khvanchkara. It has disappeared since then, and probably will never return. What a pity...

After this, Zhenia and I set out on foot to Sochi. This adventure was reminiscent of the famous travels by Ostap Bender<sup>55</sup> along the Georgian military road. Money was very scarce. We ate whatever we found along the way, slept in parks, on beaches, and on benches. In Sochi, while boarding the train, we realized that my literature teacher was in the next car. Zhenia immediately started to hatch a plan to seduce her, but he was in poor shape: his lower lip

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<sup>54</sup> Georgian semi-sweet, red wine.

<sup>55</sup> Ostap Bender is the main character in the famous comedy novel “Twelve Chairs.”

had become enormously swollen from the poor quality food. To keep the lip intact, he tied an enormous bandage around his head, which made him completely unsuitable for any amorous pursuits. Instead, he took on the role of a puppeteer to guide me. Everything turned out relatively well. Sitting on the steps of the train car, we rode merrily across the blooming south. At the stops, she bought us loads of tomatoes. As far as I know, Zhenia still cannot stand raw tomatoes. I developed a great relationship with the teacher and she helped me get the gold medal by correcting mistakes in my final essay, which I mentioned earlier.

My last years in high school were occupied with physics, the physics club, and lectures at the university, but I still loved theater. We stood in nighttime queues, bought “extra” tickets right before shows, went to the Bolshoi Theater and to the Conservatory. This was mainly Zhenia’s influence and the influence of a girl I was dating at the time. She was actively preparing for a career in theater, and I had to make an effort to fit the bill. We discussed the meaning of life, read Aristotle, Nietzsche, Otto Weininger. Sigmund Freud was too inaccessible for some reason. It then became time to apply to the physics department at the Moscow State University where I wanted to go.

My father died in this last year of high school. He was a deep believer, like my aunt Vera. But they did not attempt to convert me to the Christian faith. On the one hand, I suspect that they wanted to avoid causing problems for me at school and in life, and on the other hand, they gave in to

my grandmother's German rationalism. At the same time, they did not obfuscate the truth and did not hide their views on the so-called "communism."

As a result, I knew pretty well what was really happening and started building my double life. I realized the potential consequences of an accidental slip-up and every night would try to recall whether I said something unnecessary. My father was a deeply moral person – he could not pay a bribe, ride without a ticket, lie. But even he could not survive without a double persona. To him this was a tragedy, but for me, it became the norm. My father could not take a managerial position at a large plant because he was not a member of the party (neither could his brother, who stopped at the position of an Honorary actor<sup>56</sup>). Yet he was one of the top factory builders in the country; he created the firm "Steel Construction Projects," and he was allowed to be its head.

My father graduated from the Moscow Institute of Railways very early, and at 18 began independent work on bridge construction. He wore all the different hats – he was the manager, he prepared documents and did accounting, he hired the workers. The final product was the finished bridge. And on the bigger projects – on DneproGES, Magnitogorsk, Sevmash, on the steel foundation for the Palace of the Soviets, on the steel shells of the tall apartment buildings in Moscow (we called those under-scrappers<sup>57</sup>) and on all the others – he aimed to complete them.

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<sup>56</sup> Honorary actor was a high rank of recognition, while People's actor was the highest.

<sup>57</sup> As opposed to sky-scrappers.

Another proponent of this philosophy was Igor Vasilyevich Kurchatov. He liked to tell this story. Before entering the university there was a questionnaire for prospective students. As the joke goes: one lady's answer to the question "Nature of activities?" was "Activities happened, but nature did not take." The traditions of the Kurchatov Institute paralleled those of my private life, and I, as much as possible, always tried and still try to bring everything to completion, although this does not materialize too often. The widespread philosophy in academic circles of "My job is to perform basic science – completing the process is someone else's task" is foreign to me. This does not mean that I don't appreciate the value of pure curiosity, including at the government's expense, i.e. at yours and mine, as L.A. Artsimovich liked to say. On the contrary, curiosity is the most important inborn trait of mankind – it led to the creation of modern civilization. But let's not get ahead of ourselves. Bright, clear, white light is produced from pure colors of the rainbow. If the colors are not pure, then the light turns out to be faded and grayish. The concept of fundamentality could lead to the concept of uselessness and irresponsibility as happens so often, unfortunately, in Russia. Well, not only in Russia...

My father was a highly intellectual person; he respected intelligentsia and shared its liberal views. But he always asserted that our education was subsidized by many people who did not partake in the benefits. We should feel not only gratitude, but also acknowledge our debt to them. After all, I received not only free education, but also a stipend, medical care, and lodging. Someone paid for it all. The beauty of a debt is in its repayment. This is why from

the beginning of perestroika, and still now, I am against the theory of pseudo-liberals that we need to free ourselves from the burden of debt that is contributing to brain drain. I am for the freedom of choice in citizenship, nationality, and religious beliefs, but I am not for the freedom from debt and conscience. I voted for the law about the freedom of the conscience, but not freedom *from* conscience.

Once my father obtained an anthology of Russian 20<sup>th</sup> century poetry, and I got to know the great poets of the Silver Age.<sup>58</sup> He also fostered my love for A. Vertinskii,<sup>59</sup> whom I still admire today. I got lucky – I attended nearly all of his concerts after his return.

My father could not afford to give me more of his time – he lived his entire life as if at war, and died from overexertion at the age of 47. He got up in the morning to go to work, but a blood clot got ruptured and agony began. I did not witness his last moments since I ran out to the pharmacy for an oxygen mask. Of course, most of all, he was concerned about our futures. We buried him at a German cemetery underneath a column dedicated to Levenshteins.

Now there were three of us on aunt Vera's shoulders: Vovka, her daughter Irina, and myself. My aunt started out her life in a family of a Governor-General, but then, in Stalinist Russia, she was left without a permanent job and a pretty meager pension. But she overcame. There are such

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<sup>58</sup> Silver Age is a term traditionally applied by Russian philologists to the first two decades of the 20th century.

<sup>59</sup> A famous actor, poet, and performer.

women in Russian villages...<sup>60</sup> without even a slight complaint or traces of bitterness. She was always energetic and hopeful for the future. She managed to help her elderly uncle as well, who lived out his final years in our room behind a screen. Before the Revolution he was a successful businessman and prospered during NEP<sup>61</sup>. He owned a mansion near the Belorussky Rail Terminal. He invited the great sculptor S. Er'zia to use his attic as a studio. Grandfather would tell us stories of how, close to collapse from hunger and frigidity, he lugged huge pieces of marble to the attic. S. Er'zia found his style, and so began the marble period of his career. Then he left for Argentina and perfected the use of hard red wood. He lived in a palace and ate oatmeal that he cooked himself. I acquired this habit of cooking oatmeal as well and make it for breakfast to this day. After the War, S. Er'zia bought out his entire collection, sent it to Moscow and handed it over to the government free of charge. He asked only that a museum be established. But for his sculptor brethren, this task turned out to be too much. After much trouble, the S. Er'zia museum was built in his hometown of Saransk...

Aunt Vera also helped aunt Beba, the wife of her deceased brother, who was sent to a labor camp because of her neighbors in Krasnaia Pakhra. After she finished her time, she lived with us in the dining room and slept on a bed behind the table. She would wake up right around lunch time, and, sitting in her nightgown on the bed, she translated Saint-Exupéry. She lived in Paris for many years, smoked like a chimney, and died because of it in the end.

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<sup>60</sup> From a poem by Nikolai Alekseevich Nekrasov.

<sup>61</sup> New Economic Policy that was implemented in 1921 under Lenin and was disbanded in 1928 by Stalin.



In my room, besides my grandmother and I, there lived her lover's sister, Natalia Fedorovna, with her husband, Lord Iashvili, once a Yesaul<sup>62</sup> in the "Savage Division"<sup>63</sup>. They both went through Solovki and Kolyma<sup>64</sup>. Every morning, Natalia performed the following ritual: upon waking up, she would give the finger to the dear leader, whose image hung above my bed, placed there by my grandmother just in case, and would repeat "You see, I'm still alive after all." At Kolyma she got to know all the top people from the Leningrad's NKVD<sup>65</sup>. So I heard about the death of S.M. Kirov<sup>66</sup> firsthand. Natalia Fedorovna was an ardent pro-monarchist and deeply despised the Bolsheviks. They killed her father and brother in front of her eyes, and because of them she never made it to Paris (her father promised to pay for the trip as a high school graduation present). Natalia Fedorovna admired Napoleon, and "L'Aiglon"<sup>67</sup>, along with "Cyrano de Bergerac" by Edmond Rostand, were our regular coffee table books.

At one point, the famous geophysicist Aleksandr Petrovich Gol'tsov lived with me. In time the two of us became close friends, but everything started off fairly unceremoniously. He was getting ready to leave his first wife – a ballerina in the Bolshoi Theater. My grandmother introduced me to her family, so I could console her. Instead, I made friends with the unfaithful husband. During

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<sup>62</sup> A captain rank in the Cossack Army.

<sup>63</sup> A cavalry division formed by the Imperial Russian Army in 1914.

<sup>64</sup> Sites of labor camps.

<sup>65</sup> The secret policy organization of the Soviet Union that carried out acts of political repression under Stalin.

<sup>66</sup> A prominent member of the Politburo of the Central Committee of the Communist Party.

<sup>67</sup> A six-act play on the life about the life of Napoleon's son, Napoleon II.

the war he ended up in a Russian death camp but was released because he had a case of open tuberculosis. With this tuberculosis, he started a new family and lived a happy albeit short life. We are still in touch with his relatives.

Besides the full-time residents, there were many of the friends who met aunt Beba at the labor camp: the wife of Nâzım Hikmet<sup>68</sup>, the lover of Pasternak<sup>69</sup>, the famous writer Oleg Volkov who, on invitation from V.M. Molotov returned from France where he was part of the French Resistance movement, and many others. Upon his arrival in the Soviet Union, O. Volkov<sup>70</sup> ended up in the labor camp almost immediately. After he got out, one of his friends from the Résistance remarked: “You know, when they sent you to camp, I couldn’t help but think that there was a reason for that.” Volkov quipped - “When they didn’t send you, I suspected the same thing.”

This is the kind of “Noah’s Ark” that grew out of our section of the apartment. In the other two rooms there lived the Kogan family and two elderly ladies with a daughter. The Kogans moved to Moscow before WWII; he had a position in a Party’s district office and she was in the trade union. He was a very sweet and amusing person. Once, he dragged in the first Soviet Polaroid-style camera. I have never seen such an apparatus before or since. He taught me how to dance the tango and the foxtrot. I still enjoy these two dances to this day. Otherwise, in the theater club they only taught us pas de quatre and pas de trois<sup>71</sup>. In those

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<sup>68</sup> Nâzım Hikmet Ran (1902 – 1963) was a Turkish poet, playwright, novelist and memoirist.

<sup>69</sup> Boris Leonidovich Pasternak (1890 – 1960) was a Nobel Prize-winning Soviet **poet** of Jewish descent.

<sup>70</sup> Oleg Volkov, pen name, O.W. Osugin, (1900 - 1996), Russian writer, journalist and translator. He spent 27 years in prison camps and exile.

<sup>71</sup> Classical French ballet moves.

years that I remember, Kogan's life was burdened by the so-called "fight against cosmopolitanism"<sup>72</sup>. This was the late period of the Stalinist anti-Semitic era. They were fired from their jobs and forced to make ends meet day-by-day. Plus, this is when the "Doctor's Plot"<sup>73</sup> started. My family's reaction was the correct one – we helped as much as we could, but a panic broke out all around us. Even such a cultured and independently-minded woman like grandma Zhenia started believing in the rumors.

Why did the authorities tolerate our eclectic gathering?! I cannot speculate. Mostly, I think, it was because of the wisdom and diplomatic savviness displayed by grandma Zhenia and aunt Vera. Of course, the authorities were fully aware of the situation – every building had its own "informer." He made visits to the apartments and talked to the residents daily. But the neighbors apparently did not snitch on us, and all worked out.

For the summer, aunt Vera took a job as a housekeeper at the kids' camp run by the chief administrative body of the ministry which oversaw my father's office, and I was given a job as a radio operator there. I received all the equipment, including the wonderful radio "Kazakhstan" that picked up short-wave frequencies, unlike the other models on the market. It was possible to catch the "Voices"<sup>74</sup>, since at some frequencies they would

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<sup>72</sup> A Soviet-era campaign to stifle pro-Western sympathies among the intelligentsia.

<sup>73</sup> An anti-doctor campaign based on rumors that Jewish doctors were mistreating high-up Soviet officials.

<sup>74</sup> Western radio stations such as "Voice of America" or BBC.

burst through the jammers. I went off to camp to organize the station.

The camp was situated on the Moscow side of the River Oka between Serpukhov and Tarusa in the village of Saltykovka. For some reason I am convinced that this is the same village where the older brother Golovlev from the novel by M.E. Saltykov-Shchedrin<sup>75</sup> lived out his last days in sadness. At least, during drizzling rain, the view outside of my little hut's window onto the slippery muddy sides of the nearby ravine was definitely reminiscent of a scene from the book. Grandma Zhenia with Vovka and aunt Vera rented a corner in the hut, but I lived in luxury at the radio station. There was also Grisha - a trumpeter from the Eddie Rosner orchestra. He instilled in me a love for genuine jazz and trumpets. Besides being a radio dispatcher, my duties included helping the local gypsy prepare meat in the kitchen. He would strike a young bull in the forehead with a masterful blow, and we would drain the blood and flay the animal. The gypsy also had a moonshine operation.

My second duty was to help the truck driver load the groceries and firewood. Deep in the Russian countryside a truck driver occupied a very special social position. As an "owner"<sup>76</sup> of the lorry, he was economically independent and mentally free. He was exquisitely well-versed on all issues, ranging from the local rumors to world problems. His innate sense of humor was on par with that of a Russian peasant, and he expressed himself in rich and expressive language interspersed with just the right dose of swear words. In my lifetime, I had the privilege to interact several

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<sup>75</sup> The novel is aptly titled "The Golovlev Family."

<sup>76</sup> It was illegal to privately own trucks or buses in the Soviet Union.

times with these types of people, and this has thoroughly enriched my life. On one trip to get firewood, at a risk to our lives, we were crossing a small bridge across a river. He suggested that we completely break the structure off. Let the kolkhoz<sup>77</sup>, he said, rebuild it. Seemingly, the bridge had not been repaired since the Revolution. We cut it down, but when we came back a week later, the bridge was lying in the same exact position on its side. Everyone was just fording the river. It could be that they are still fording. Early in the mornings, when we would head to Serpukhov to get the groceries, I observed a scene that was unfamiliar to me at the time: mobs of drug addicts gathered on the steps outside the pharmacy waiting for it to open.

Our circle of male friends also included a Ukrainian laborer. He was a petty officer in the army, possessed incredible strength and a heroic calmness. He would tell us how before a battle he would drink his 800 grams of vodka and march off to attack. I believed him completely. The final man was a local Kulibin<sup>78</sup> and the hut's owner where we rented a corner. He was in charge of the diesel generator. Its RPMs were controlled with a match and an elastic strap from an old pair of underwear – which resulted in very mediocre stability of voltage.

From a young age, I always loved radio and spent countless hours sitting in my radio room. The female staff was represented by a wide spectrum. At the left, there was the wife of the camp leader, Grisha. He would systematically beat her and her suitors. At the right, there was the classical Stalinist-era school principle. Considering

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<sup>77</sup> A Soviet collective farm.

<sup>78</sup> Ivan Petrovich Kulibin (1735 - 1818) was a Russian mechanic and inventor.

also that Vovka ended up in the hospital with an appendicitis attack and then managed to escape from there, there was little time to be bored.

The grand finale turned out to be the good-bye dinner. The lady-director splurged on a bottle of port<sup>79</sup>. This was so disturbing to Grisha that he stole the bottle; we drank all of it and replaced the contents with some lousy booze. I had to miss the first half of the dinner because I had to set up a broadcast. When I got to the cafeteria, the dinner was in full swing. The gypsy poured me a cup of moonshine out of a large metallic milk canister, then another. And just as I was, in rubber work boots and up to my knees in dirt, I went out on the dance floor. There was no time for food. I invited aunt Vera to dance. Quickly she talked me into leaving and going to bed. I am an appeasable individual, so I went. I got all the way to my porch. On the porch there was a white ghost in underpants. I tried to walk around it but did not succeed. So I hugged it and the both of us fell off the porch straight into a pit of liquid dirt. He landed first and I on top of him. Immediately I fell asleep. How he made it out from under me, I can't remember. In the morning during the line-up, we found one of the workers peacefully slumbering with his hands around a flagpole. My ghost turned out to be a minor executive from the headquarters, who was visiting the campsite for boarding. He did not want any scandals and slipped away quietly, just like is proper for a ghost. The line-up had to be canceled. The director sighed out loud with sincerity, "How is it possible to get that drunk from one bottle of port?"

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<sup>79</sup> In Russia the cheapest fortified fruit wines are referred as "port."

At the end of the summer, there was sad news – grandmother Zhenia passed away. She died quietly during the night. She suffered from asthma and angina. It could be that she died from a heart attack, or it could be that she died due to stress, as they say today. When father died, aunt Vera became her caretaker. Her son got caught up in another party “cleansing.” Unluckily for him, he joined the Party right before the Germans attacked Moscow. He was accused of attempting to betray his homeland. His family name – Evreinov – probably played a role as well. After all, he could not interject that the name is of an ancient Russian noble origin. In the past he would joke: “In the entire Ministry of Automobile Manufacturing there is only one Russian and even that one is Evreinov<sup>80</sup>.” But now was not a time for jokes, and grandmother always feared that as a consequence he would be sent to either a labor camp or prison. Whether this incident was the final straw or whether she helped her passing along, which is likely considering her personality, we will never know. We buried her in the village cemetery, her remains driven over on a horse cart. There was just a little longer she and my father would have had to live to see the death of the mustached villain (Stalin), but it was not to be.

During the summer I passed my interviews and was accepted to the Moscow State University’s physics department. Besides the gold medal<sup>81</sup>, I also had certificates from various scholastic competitions, from participating in

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<sup>80</sup> The root of “Evreinov” in Russian means “Jew.”

<sup>81</sup> Highest honor in high school.

artistic exhibits and a personal pension – all of which enriched my portfolio. The interview was carried out by Pugachev, the very same one that kept watch over P.L. Kapitsa<sup>82</sup> during his house arrest. I remember only one question. He questioned me about some Japanese last name. From general knowledge, I answered that he is probably a war criminal. “No,” he said triumphantly, “he is the Secretary of the Communist Party.” Nonetheless, I was accepted to the University.

The complex in the Leniskie Gory<sup>83</sup> was not yet fully built, so we had classes on Mokhovaia and in Sokolniki. The atmosphere was very patriarchal. During the breaks you could run down to the cafeteria, quickly eat some meatloaf and finish with a glass of vodka. The first-year coursework in physics and math was already familiar to me (there were some gaps, as is common with self-education), so I had a bit of free time. T.P. Kravets helped me get a position with an advisor, a corresponding member of the Soviet Academy of Sciences, V.K. Arkadiev, and the two of us began choosing a field to focus on. Right at this time the book by Hannes Alfvén titled “The Cosmical Electrodynamics” came out. In the U.S.S.R. no one was yet working on this topic. I was familiar with Maxwell’s equations and had a very good grasp on the model of electromagnetic fields. We chose this direction, as it turned out, for the rest of my life. I wanted to create Alfvén waves in the laboratory. For this we needed a conducting liquid but had only mercury. At this time there was plenty of

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<sup>82</sup> A Soviet physician and a winner of the Nobel Prize for Physics in 1978.

<sup>83</sup> The Main Building of Moscow State University, the iconic skyscraper of Stalin era, is located at Leninskie Gory (Lenin’s hills).



mercury everywhere: at the laboratory of V.K. Arkadiev where it was used by his deceased wife Glagoleva-Arkadieva, and at my school's physics club which I still continued to direct. I adapted a bathroom cup for shaving materials and a small motor with a propeller, and found some sizeable electro magnets. Now at the laboratory, I had access to powerful sources with consistent current, and at the school I had a rotary converter. So I obtained a non-trivial result fairly quickly: a magnetic field can destabilize the flux (counter to the then-widespread belief in the opposite). The reason was simple: without the field the mercury in the cup rotated homogeneously, but with the field, there formed a spinning cylinder above the propeller along the magnetic field lines. The mercury clung on the periphery of this cylinder. As a result, between the spinning and the still mercury, a thin cylindrical layer is formed by the great drop in speed, and within this layer, due to instability, a revolving vortex path is created, a beautiful ring of vortices, just like in a ball bearing.

A similar phenomenon was observed in Sweden by B. Lehnert, but I did not know this at the time. But truthfully, this is only one half of the story. The theoretical second half I completed for my diploma's final project. Today, this is my most often cited work that has not been finished by me nor by other researchers who have been toiling at the problem for the better half of a century. But I'll come back to this later.

To create Alfvén waves, I tried to spin out the mercury as quickly as possible, including spinning induced by an electric current. The mercury boiled, angrily spat bubbles, but refused to spin any faster. Right at that time, V.K.

Arkadiev died and I was thrown out of the laboratory pretty swiftly. It turned out that his colleagues hated him and his wife and their mercury. They were much more attracted by the so-called philosophical problems in physics.

1952 was the peak of lunacy for science in the Soviet Union. Among the published works that year were the “brilliant” volumes on linguistics and economics written by the “Great Leader.” The XIX Congress of the Communist Party came and went. Following a party directive, Comrade I.I. Prezent unleashed a period of Lysenkoism.<sup>84</sup> The “distinguished” party scientist O.B. Lepeshinskaia busied herself creating autogenesis out of mud, and her scientific progress was strengthened and widened by the “wonderful” son of the Armenian people, Comrade Bash’ian. The “eminent” philosopher E.Ya. Kolman undermined quantum chemistry along with the theory of resonance. A.A. Maksimov – a corresponding member of the National Science Academy of the U.S.S.R., deeply loyal to the party and personally to comrade Stalin, along with the party bureaucracy was preparing the destruction of modern physics. An enormous gathering on the matter was stopped mid-flight by an ultimatum issued from I.V. Kurchatov: either continue the Marxist obscurantism or get the bomb. The leader chose the bomb for the time being.

Beginning in the mid-30s, after the shooting of Dean B.M. Gessen and the destruction of the O. Mandelshtam school, the physics department became a pillar of reactionary thinking and obscurantism. From the podiums

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<sup>84</sup> Period of campaigns to manipulate genetics, science and scientific results for political gain.

one could hear crushing speeches addressed to Albert Einstein and Niels Bohr. I retreated quietly to the acoustics lab and worked on soldering an amplifier with super-amplification capacities. Later, Kolia Rambidi introduced me to students in the chemistry department, and I began putting together a 4-millimeter interferometer to use for radio spectroscopy.

Student life in the physics department took its course. I did not attend lectures, so I never bothered to learn analytical geometry. The famous physicist Modemov gave me a “failed” grade. The three of us with failed grades (I, another friend and classmate, and Mukhin from the older class) got together to mark the occasion on the top floor of the restaurant “Moscow.” Nearby was a guy from the North, who started treating us to appetizers and plenty of drinks. Once solidly drunk, he declared that he never met us and refused to make good on the payment. Somehow we squeezed together the necessary amount, but anger remained. Upon exiting the restaurant, we couldn’t think of anything better to do than to seek revenge on him right in the middle of the Sverdlov Plaza. We were picked up almost immediately and escorted to the station. While filling out the report, it turned out that the northern fellow had a considerable sum of money on him, and we were immediately released as unnecessary witnesses. We’d gotten extremely lucky. I had about 3 or 4 of these types of close calls during my student years. This is despite us getting drunk on a regular basis: we would start with the Esenin basement (now the “Children’s World” store), continue on to the cocktail-bar at the beginning of Gorky Street and end with a pub at the Pushkin Plaza. But fate

kept us intact for some reason. There were also other risky endeavors. One professor that I knew signed me up along with my school friend Goga for a club that studied the falsification of history under Lenin. This had Article 58<sup>85</sup> written all over it. Yet no one snitched and all turned out well. This is how we spent that first year.

The University's move to a new building coincided with the death of the Leader. It was spring. I remember a sunny day and a joyous feeling of liberation. It was only sad that my grandma and my father did not live to experience that day. Needless to say, my feelings were in stark contrast to the genuine or the feigned expressions of mourning written on the faces of everyone else – this only served to underline the deep schism that divided us. But I was already used to it and worked around it as necessary. I went with my college buddies to the Column Hall<sup>86</sup>. Why? I cannot tell. Perhaps just in case, or maybe it was simply groupthink. We got as far as Trubnaia Plaza and had a very difficult time rescuing our girls from the midst of the ensuing stampede<sup>87</sup>.

In addition to tutoring, during this same period I got a half-time position at the Institute for Electrification and Mechanization of Agriculture, where my grandfather, Mikhail Grigorievich Evreinov was the director. He had a special relationship with N.A. Bulganin<sup>88</sup>, but he did not advertise this fact. Through the connection, my grandfather's institute had a pulsed power source from the

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<sup>85</sup> An article in the criminal code of the U.S.S.R. that put individuals on an “enemy of the people” list.

<sup>86</sup> An official concert hall in the center of Moscow where Stalin's funeral was taking place.

<sup>87</sup> Stalin's funeral resulted in an enormous death toll.

<sup>88</sup> Nikolai Alexandrovich Bulganin (1895 – 1975) was a prominent Soviet politician, who served as Minister of Defense (1953–55) and Premier (1955–58).

potent radar station and tried to use this technology to further agricultural interests: for example, by running pulses through the soil, scientists attempted to destroy hibernating Colorado potato beetles. Grandfather gave me the job to statistically double-check their results. From the textbook by A.V. Leotovich (a father of the academician), I learned the basics of the probability theory and the method of least squares and then reviewed the results. It turned out that the average beetle's statistically calculated lifespan grew with the radiation dosage. This result was not in favor with the agricultural scientific community, so they simply tried to get rid of me, which did not succeed. So it was time to re-think the theory. I proposed the following hypothesis: the beetle perished primarily because of digestive diseases, and the pulses could be destroying a parasitic microorganism – i.e. it acted as a sort of physical therapy for the bug. The scientists picked up the theory and started to develop it into creative spheres, but I decided to distance myself from the mess. Besides the material results, this experience was also very satisfactory morally, because it demonstrated the practical value and power of the scientific method even in this obscure field. With all these adventures, my life was fully booked.

In the summer I went to the Sokolova Pustyn' on the Oka River to visit a buoy keeper that I knew – her son and I were friends. Life there was very strict. We all slept in a hayloft along with the buoy keeper and a military man (who was a very enterprising fellow, a retired officer). By around noon we would wake up and climb up on the roof to

sunbathe. The buoy keeper would feed us potatoes fried in pig fat and would put out cucumbers and a bottle of vodka. After the late breakfast, we would walk out to the Oka shore and spread out a 500-foot long net off a beach where a herd of cows came everyday to drink. The net filled up with the so-called “shit feeder kings” – a small fish about 8 inches in length. The size of the catch was usually 3 or 4 large laundry baskets worth. The process was to clasp each fish in our fists, and as it opened its mouth to pour in about 150 grams of sand. After this procedure, the buoy keeper put the baskets on a yoke, brought the fish to the vacation renters and sold them by weight.

Two or three times we boated all the way up to Serpukhov against the current hooking onto a passing barge. At the top we dragged the same 500-foot net down the river: two in the boat (one paddled with his hands, the other, lying on his back, with his legs), and the third person walked with the net along the shore, since the net could not be released. Sometimes, in boots and telogreika, the third person would accidentally fall into the river. He would get out, everyone would dry themselves by the fire, and continue on. The fish caught were much more varied and tasty. Occasionally, though, we would ensnare a school of ruffs by accident. Then the net turned into a long prickly line, which took several hours to untangle. This is how I spent about a month and a half before I returned to Moscow in September.

During this time, L.P. Beria was executed and power was left in the hands of N.S. Khrushchev and G.M. Malenkov. A slow thaw of the regime commenced. Life improved slightly and people had high hopes for a bright

future. In October, the physics department underwent a very momentous change. After the expulsion of P.L. Kapitsa, students who were working on atomic and nuclear physics from the Institute of Physics and Technology were transferred to the physics department here, and a department to study the structure of matter was established. Thus, along with the new research institute on nuclear physics there was established a center to prepare experts on new nuclear specializations – all with an air of secrecy and of special importance for the country. The new students brought with them liberal thinking and a confidence in their mission. This was immediately apparent at the department's Komsomol meeting<sup>89</sup>. Open and harsh critique was voiced of the professors, of faculty and the content of education itself, for lack of eminent scholars at the department, and for obscurantism. All of this activity was driven by the upper classmen, and we – the first- and second-years – were primarily the ecstatic audience. I, however, could not hold it in and complained about our physics professors. The reaction at home was unexpected. It turned out that in his youth, the old professor B.K. Mlodzevskii dated grandma Vera, and they became very upset with me. The meeting, though, yielded a radical resolution with a demand for reform, and it was decided to send it straight to the Presidium of the Central Committee of the Communist Party. A huge scandal erupted. The chancellor's office, the local party committee, the regional party committee, and the Komsomol party committee of the MSU were up in arms and tried to quiet the rumblings. Not

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<sup>89</sup> Komsomol stands for Communist Union of Youth, and was a branch of the Communist Party aimed at older youth (14 to 28 years old). Younger children were members of the Young Pioneer Organization.

so fast! People at the meeting, taking a cue from the French national meetings at the time of the French Revolution, refused to disperse, passed the resolution and dispatched it straight to the Presidium of the Central Committee, bypassing all the regular hierarchical channels. My personal involvement in this action was largely passive, although the action itself and its success played an immense role in the development of my self-awareness and character.

In December, prominent academicians led by V.A. Malyshev, the head of the Ministry of Special Machinery – i.e. atomic industry, addressed to the Central Committee a similar letter, which set the wheels in motion. In 1954, the dean was replaced, leading experts were invited to join the faculty – I.E. Tamm, L.D. Landau, M.A. Leontovich, and L.A. Artsimovich, and new specializations were created, including one on atomic physics. I submitted a request and, along with a few friends, was transferred to the department on the structure of matter. Studying became more interesting and I even began attending a few classes – for example, the lectures by professor I.E. Tamm. Usually he would fill the entire blackboard with tight lettering by the end of the lecture and mutter: “Well, I got a bit tangled up, but tomorrow I will explain everything.” We participated in his creative process and it was wonderful!

There was very good applied practicum and a fantastic practicum on radios. I continued to work in the chemistry department on my radio interferometer. The frequency had to be increased (since only the 8mm models were available commercially and the interferometer was 4mm), the rest of the apparatus had to be fashioned, synchronic detection had



to be perfected, etc. The MSU was well supplied. I visited A.M. Prokhorov's lab for consultations, which were tremendously helpful, and we established a close personal relationship for life.

Our department had a very active student travel organization. After my peregrinations with Zhenia through Russia and the Caucasus, I got interested in traveling around Moscow. This was the beginning of the cultural era later characterized as the "Decade of the Sixties," which embraced B. Okudzhava, V. Vysotsky<sup>90</sup> and other bards, as well as the new theater movement and underground press. But I had many other interests and never fully immersed myself in this.

In the summer of 1954, I arranged to work as a collector for an expedition with the geography department in the sub-Arctic. The expedition was supposed to collect data for a planned railroad, slated to run from Europe to Asia through the Kokpelski pass in the Ural Mountains. My tasks consisted purely of housekeeping: to collect all the equipment and the necessities for the expedition and to load them on the train going from Moscow to Vorkuta. Together with the surveying team of railroad engineers we headed to the train station, which was the beginning of the infamous "Dead route" to Labytnangi, Salekhard, and Norilsk. The only completed section was to Labytnangi. The road was built by Gulag prisoners, and there were labor camps set up all along the entire length of the route. After Stalin's death, construction was halted and the camps closed. That year

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<sup>90</sup> Some of the most influential and popular bards in the Soviet Union.

Malenkov<sup>91</sup> famously declared amnesty for many of the prisoners.

The segment between Moscow and Kotlas was particularly memorable because of intolerable heat and the necessarily shaky adaptation period to the temperament of engineers and geographers.

In our group there were two bosses – the top one, and my boss, his deputy – as well as two data collectors, a female student and myself. Initially I had my sights set on her, but then it was explained to me that she was already taken. The railroad engineers' chief was a major, weighing in at just under 300 pounds. One time at a stop we ran out to get some beer. It turned out that the beer cistern and the queue to the cistern were on the other side of a fence. I started climbing up the fence, and the major, despite his girth, simply spryly hopped on top of it. The fence crumbled under the weight and collapsed onto the cistern and the crowd. We managed to flee, but without the beer. On the train, he spent time teaching me how to drink undiluted spirits<sup>92</sup>. A water glass was filled with the spirit and then topped with a thin sliver of sweet liqueur. Then, after a deep exhale, the entire thing had to be drunk at once. The learning curve was very steep, and any misstep in execution was fraught with disastrous consequences. Another novelty for me was the less-than-standard sexual orientation of the major. Fortunately, he acquired a partner early on, and I was in the clear, but this was my first experience with this phenomenon.

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<sup>91</sup> Malenkov was Stalin's close associate and from 1953-55 was the most prominent Soviet politician.

<sup>92</sup> Spirits have proof as high as 175 or nearly 100% pure ethyl alcohol. In this book, the word "spirits" refers to this drink rather than as a general umbrella term commonly used.

My education on expeditions was proceeding very swiftly. At the final stop we transferred the baggage and headed to Labytnangi. Our pace diminished because the railway, which was built on permafrost, started to bend and curve as years passed. On either side we passed abandoned labor camps with watchtowers and barbed wire. “The Russian expanse is a haven for geese...<sup>93</sup>” The gates to the camps were adorned with faded slogans: “Welcome!”

In Labytnangi we stayed in a little house built for such expeditions and started to get ready for the trip. We hired horses, a local guide and three workers – two of whom recently received amnesty, and one who was of the Komi<sup>94</sup> ethnicity and a master of many trades, and who looked like a Native American from Fenimore Cooper’s novels. We traveled on a small motor boat to Salekhard through the Obi valley. The view was ineffably magnificent! An enormous river without an end or borders! The shores were very shallow, overgrown by forest-tundra. I was there for the second time in my life 53 years later and experienced the same excitement.

Salekhard could not be seen from the river, but after one turn we saw empty bottles bobbing in the water, and finally there appeared a shore with dilapidated huts and a few urban buildings. The coast looked spectacular. There was nagging heat, and the shoreline was dotted with bathing men, mostly recently released prisoners. Needless to say, the stores carried no swimming accessories, so they swam in variegated women’s trousers – the same style that

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<sup>93</sup> The first line of a famous poem by Vladimir Turianskii about the beauty of rural Russia.

<sup>94</sup> Komi people live in the Ural and northern regions of Russia and emphasize subsistence-based living.

Gérard Philipe<sup>95</sup> discovered in Russia and demonstrated in Paris<sup>96</sup>.

We sent off the horses and the workers with the guide through the tundra to the meeting point by the Kokpela River, and started negotiations with the pilots to arrange for our drop-off. There were two-seater planes of the “Sh-2” Shavrov<sup>97</sup> types. These were single-engine machines built of plywood and covered with aluminized fabric, which took off from water and could land on the small lakes that were ubiquitous on the tundra. The first flight took off with my boss, E. Kunegin, and a few cases of sweetened condensed milk. Meanwhile the town was gripped by an emergency. Someone got lost on the tundra and a frantic search began. During the search, the pilots used up their limit of flight hours. Kunegin was abandoned at some lake, had to survive on the condensed milk and spent time sending out flares. L. Dolgushin (the main boss) took up the negotiations with the pilots. The final terms of agreement were for us to help repair the fabric on the planes and to drink a can of spirit together. All of this was left to me. The task turned out to be much more difficult than anticipated, especially the drinking part, but I managed. We were dropped off at the lake, and soon the horses and the rest of the crew arrived.

On the evening of the first day, I decided to demonstrate my enthusiasm for work. I knew how to handle a three-row net but did not account for the possibility that the net was not in good condition. The weights sunk through the netting. I was in a small rubber

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<sup>95</sup> Gérard Philipe (1922 – 1959) was a prominent French actor, who had appeared in 34 films between 1944 and 1959.

<sup>96</sup> A scandalous episode from Gérard Philipe’s biography.

<sup>97</sup> An aircraft of amphibious design.

boat untangling and setting the net, and was being devoured by gnats and every other creature around: mosquitoes, midges and the most aggressive little bugs – black with white legs, they looked like a miniature version of government limousines, ZiL-110s. This bug did not suck blood; it actually fed on the flesh. I rowed, untangled and set the net, and splashed my face with water. Somehow I managed, and then went to bed. The next morning when I came out of my tent, I was amazed: I saw the world around me like through a narrow tank visor. Others, when they glanced at me, burst out in laughter. There were no more eyes or ears on my face. My head resembled an enormous whitish-pinkish balloon. “And the Russian folk gasped in terror – What a mug, what a terrible erysipelas!” (From A.K. Tolstoy<sup>98</sup>.) It turned out this experience provided me with a powerful immunity to any biting insect. And the fish turned out to be some of the tastiest in the world – Siberian whitefish. I was taught how to salt them – a small amount of salt was applied to the inside of the fish and then they were buried in moss; a day later the meat started to fall off the bones and the texture resembled cream cheese.

Before our departure, we celebrated the day of railroad workers as is proper. I made a *faux pas*, however. The guide demanded that we drink some more, so Kunegin sent me off to get more spirit. I wanted to save our scarce resources for later, so instead I poured him a glass of cologne, which was very politically incorrect. The guide’s face was equivalent to that of F. Ranevskaia from the movie “The Wedding<sup>99</sup>.” In the movie, A. Gribov fills her

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<sup>98</sup> From his poem, “Zmei Tugarin.”

<sup>99</sup> A 1944 comedy.

drink with something and after drinking it, F. Ranevskaia simply stood there with a frozen countenance and a bit of liquid dripped out of the corner of her mouth...

The guide stood up, exited, and we never heard from him again. The loss was not very significant, since we had a map and another guide, but I got in trouble – both for the cologne and for insulting the guide. My saving grace came after an incident with the railroad engineers: first, one of the surveyors climbed into his sleeping bag head first and nearly suffocated, but we helped to pull him out. The workers wanted to celebrate this close call by setting off fireworks, but embarked on the task without leaving their tent. We put out the burning tent and my episode with the guide was happily forgotten...

For some time we lived in tents. We hunted. One time a group of Khanty<sup>100</sup> people arrived. They gave us pelts of young female deer as gifts. The next day we went to visit them. It was the day of Ilya<sup>101</sup> - bright and sunny. All around us were snowy mountain caps. With the help of huskies, the Khanty herded together a group of deer and started identifying females with matching shades of fur for a coat for the boss's sweetheart. They laid out all the pelts and started matching them. They flayed one carcass and halved it, then pulled out all the innards and filled the cavity with blood and salt. They sat around to eat the meat and dipped pieces of it into the bloody mixture. I was singled out to represent our party. At that time my teeth were strong, plus I could hold my liquor quite well, and most importantly - I have a pug nose. But to take a bite out

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<sup>100</sup> An ethnicity indigenous to Siberia.

<sup>101</sup> Ilya the Prophet day, celebrated by the Orthodox Church on August 2<sup>nd</sup>.

of the deer's still-warm flesh is impossible. To cut up the pieces, the hosts used a sharp knife that they maneuvered right under their noses. Luckily, they, just like me, had short noses.

The next day the Khanty played the card game "To the Point," and after one of them cleaned the rest out they came to us to continue. We fell prey to the "White People Syndrome" – there is no way these boneheads could outplay *us!* I caught on pretty quickly to how foolish this notion was and left after losing two weeks worth of salary. But the others suffered much more – our guest possessed phenomenal operational memory.

We started getting ready for our trip across the Kokpelski pass. I was issued a horse – a small one, with lots of fur and a very nimble body. This point marked the beginning of my life-long admiration of horses. First we started walking through the forest-tundra, and then continued along the Kokpela. The mountain river was full of waterholes and rapids. The waterholes were home to countless grayling. I would close off the top of the hole with a small net, climb into the freezing cold water and chase the fish around until they got entangled in the net. The next part of the process was to dive down to an ensnared fish, bite through its nape before it could escape and then move on to the next one. From the comfort of the towering shore, the guide would count the loot. Right there on the shore, the others were busy setting up the portable oven and smoking the catch. Freshly smoked grayling is a fabulous delicacy, even when spirit is the only accompanying drink. Muksun, Siberian whitefish, grayling, and later in Salekhard, Siberian white salmon! At the finest

restaurants of the world I never tasted fish as delicious as we enjoyed there.

We reached the mouth of Kokpela, right where it flows into the famous river Sosva (cured herring from Sosva – a small whitefish – is considered a great delicacy; it is reminiscent of cisco fish from the Pleshcheevo Lake). Sosva is a muddy, smooth river, and Kokpela is a pure mountain stream. At the point of their intersection, the clear water is teeming with taimen fish and the muddy water with pike. The pike are scared of the taimen, so they keep their distance. Somehow, Dolgushin obtained a brand new German-made spinning reel in Moscow and could not wait to try it out. He threw in the line and a perch took the bait. He fought it and fought it and finally the rod snapped. Turns out it was just a small perch.

At the same time, the guide and I were fishing from an anchored boat. He broke off a handle from a spoon, made a hole through the middle, stuck a horseshoe nail through the hole, attached a string to the device and threw it in the water. Pretty quickly a taimen fish bit at the spoon. With great difficulty we managed to get the fish out of the water and into the boat. I still have the photo: I am holding the taimen vertically, its tail is on the ground and its head is just above my shoulder; a whole aluminum bowl, not just a spoon, could have fit into its enormous gaping mouth.

I acquired another responsibility: one of the workers foolishly shot a young eagle and I was nursing him back to health. While we were on the move the eagle was tied to the horse by one of his feet, and when he stretched his wings, he would cover the horse from the shoulders all the way down to the tail. In the taiga he had no problems



finding food; I shot ducks and quail for him. He would break the duck into three or four parts and devour each one in its entirety, including the feathers. Then he would lie down on his crop to digest the food. The digested remainders were excreted in the form of lime goo two to three meters away. There was also a sly local dog in the group, who learned how to trick the noble bird. At first he walked around the bird just out of its reach. The eagle observed his every move, sometimes turning his head upside down. Slowly the trajectory neared the much-desired duck. At a strategic moment the dog would bolt in, snap the duck and bolt out. He used the same ploy over and over again, all with success.

At Sosva we built a raft and sent the horses and the guide back to the base, and set out sailing toward the Sosvinski Sor - an enormous body of water at the bottom of Sosva, right before it pours into the Obi River. Along the way we saw moose that came to drink. They were completely unafraid of our raft. There was a flock of swans flying over Sosvinski Sor. For some period, the magnificent flock flew right above our heads. We waited for the steamboat at the mouth of the river and took it up the Obi River to Salekhard. Our company on the boat was of questionable character, but the eagle did a spectacular job defending our baggage on the deck. A white circle outside the periphery of where the baggage sat indicated the forbidden area, and no one dared to breach it. We arrived in Salekhard. By then, the eagle had already recuperated and I let him go. Even now I think of him fondly as a dear friend.

I was not going to make it back by the time the new school year began. So at the restaurant “The White House,”

while snacking on white salmon and toasting with a “White Blizzard” (a mixture of champagne and vodka), we wrote up a telegram to MGU about how Velikhov’s expedition was stuck in the mountains because of a snowstorm and a rescue mission was underway. This telegram raised my prestige in the department drastically.

This is how I found an outlet for my need to bum around. This disease, it turns out, is hereditary – my oldest son has it as well.

The department of condensed matter attracted a very strong theoretical group, and I, although continuing to work at the chemistry department, got more and more interested in theoretical physics. As a result of our victory at MGU, the quality of lectures became outstanding. My third year there passed in a flash.

The country witnessed the 20<sup>th</sup> Congress of the Communist Party, where N.S. Khrushchev read his famous report<sup>102</sup>. It contained nothing new to my ear. The Khrushchev Thaw<sup>103</sup> began. I submitted a request to vindicate my grandfather. My first attempt was rejected, since his case was related to the Prompartia case. And although my uncle did not recommend pursuing the matter further, I insisted. He was exonerated following the second petition.

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<sup>102</sup> Khrushchev publically denounced Stalin’s methods – the first time anyone had dared to do so during an official session.

<sup>103</sup> The Khrushchev Thaw (or Thaw Time) refers to the period from the mid 1950s to the early 1960s, when repression and censorship in the Soviet Union were partially reversed and millions of Soviet political prisoners were released from Gulag labor camps,

During the summer of the following year, I once again traveled to the sub-Arctic, to Karelia, with a geological expedition as a laborer: digging up test and survey pits, making food, carrying specimen and loadings, hunting and taking care of the horse. My boss was a graduate student named Andrei. He was a true workaholic, and when his surveyor and I caught up with him already in Karelia at the Lota River, he gave us our first assignment: he gave us the drill, explained how to put it together (incorrectly, as it turns out), and sent us off to drill at the marsh. We drove the drill in about twenty meters, started to pull it out and pulled out only the handle. The bit must still be in that marsh now. This sad experience was only the beginning. Andrei thoroughly studied methodology for field work as described in “Encyclopedia for Geologists” written by V.A. Obruchev. But this theoretical work helped him little in real life.

We got ready to sail up the Lota River on a rubber boat. Andrei packed everything himself in strict accordance with the academic book. Yet he put the axe with its blade facing the rubber. Right in the middle of a rapid, the axe pierced the side of the boat. We more or less collected the items, dried them up and patched up the boat. There were no other adventures, with the exception of one more. Across from where we set up our camp, a group of border patrol soldiers appeared and demanded to be ferried to our side. They were searching either for a spy or for a smuggler. Along the way, Andrei sat on the side of the boat (I was rowing) and accidentally popped out the air plug. The boat started sinking to the bottom. The water wasn't deep, and the patrolmen escaped carrying their weapons

overhead. I was convinced they would shoot us right there, but they turned out to be mild: they swore wildly, drank some spirits and left.

The rest of the trip we did on foot. The backpacks weighed nearly 90 pounds. From the campsite we would stand up abruptly, and move while “chasing” our backpacks for a while. It was dusty, hot and full of bugs... “Boot—boots—boots—boots—movin' up an' down again.” (Rudyard Kipling) One time at another campsite by the river, we were cooking pea soup with hen. Suddenly we heard a powerful noise. Along the river a flock of swans flew around the bend. Their wings appeared to be touching the shore. They were magnificent, but on the background of the setting sun they looked like birds foretelling apocalypse.

Andrei managed to acquire a horse, so we loaded it and moved on. I tied it down next to our campsite. Before we even had the chance to start a fire, the horse got loose and started galloping home with incredible speed. We started running to cut it off. The surveyor, nicknamed Elephant, never dealt with horses before and decided to approach the animal from the back. He got his teeth knocked in immediately. Finally, after catching the horse, we arrived at the border control station. There, they always fed us. I remember sumptuous warm wheat bread, baked according to the local customs, topped with creamy butter. Now, this bread is baked only in my village near Pereslavl-Zaleskii. Otherwise it exists nowhere else in the world. We ate up entire loaves of that bread and got more loaves for the road, which we devoured instantly, just as soon as we disappeared behind the nearest hill. This time, we

locked the horse up in the shed. A bag of oats was left outside. We were sitting around the fire and heard loud slurping. As we ran toward it we realized that the horse had escaped through the window and was gorging on oats. More trouble came soon, for that night we set up the tent, I hobbled the horse, and we went to sleep. During the night the border guards came running, yelling: "Is that your horse out on the shooting range? They are about to start practicing!"

Finally, our expedition came to an end, and we caught up to the rest of the group. Their horse had run off completely, and they also were closing out their season. We set up our tents right next to each other. During the night our horse roamed around a little, then dropped squarely onto me and fell asleep. I was overjoyed: there was no need to look for it in the morning. When we woke up we found strange items all around, some kind of icicles here and there. It turned out that these used to be bags with grits and sugar. Nearby lay a shattered tray for washing the collected samples. The owners of the tray wondered out loud, "What should we do with you? Should we kill the horse? It's too big and we can't eat it all. Alright, let's break camp and go to the village nearby." We got there and just started to relax as Andrei came running full speed, yelling "You didn't put out the fire, there is smoke, come back now!" We ran back. For two days and two nights, we did not eat or drink, only worked to extinguish the fire in the bog. When we returned, they gave us each a mug-full of spirit. We drank and went to the movies. I could not synchronize the two split images in my eyes. The hell with it, I thought, and finally decided

to watch the movie on two “separate screens.” I returned to Moscow pretty much on time.

I started studying with the newly formed theoretical group. The students there were very talented – I formed close friendships and work collaborations with many of them that lasted throughout my life. I took up a new hobby – riding a horse; so I joined the riding club “Thunderbird” in Izmailovo. The practicing started. Soon after I moved up to become the captain of the university’s team. Our specialty was jumping over barriers. On my team there was a very young student from the geology department named Natalia Arsenieva, who became my wife three years later and with whom I celebrated our Golden Anniversary in 2009. Later an old acquaintance remarked that our marriage was “a marriage of love, inspired by horses.” I had a suspicion that Natalia was more interested in horses at that time rather than in my personality. In 1956, our team won the Moscow Cup. The victory was celebrated by the entire team at my apartment, and then during the night we stumbled over to the Krymskii Square and crawled across the Sadovoe Circle<sup>104</sup> on all fours.

I got to know horses not only at the riding stables, but also at the horse-breeding facility in Gorki-10<sup>105</sup>. At that time there was a shortage of riders, and I was entrusted to work in the mornings with Kvadrat, the famous breeder of race horses. Now that horse factory in Gorki is decorated with his statue at the front gate. I cleaned the horses and

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<sup>104</sup> A central ring-road in Moscow.

<sup>105</sup> A suburb west of Moscow.

rode them into the pasture across the upscale suburb, Nikolina Gora. During the summers, my aunt Vera gave French lessons to the children from the elite class, and the families provided her quarters. So occasionally I spent time there, too. Besides Kvadrat, I was trusted with riding on the horses that were sent to breeding from the racetrack. Among them was the wonderful Kabardian<sup>106</sup> horse Ilkush, the Akhal-Teke<sup>107</sup> beauty, Veterok, very playful and quick, and a stallion from the Don area that was a present for N.S. Khrushchev. He also had no one to care for him, and I had to ride him. I started bringing Natalia to this place. The group was peculiar: Natalia and I, the trainer, stable cleaners, and a sculptor, Erik Giliarov – the creator of the Kvadrat statue and of many others. The rules were simple – whoever fell off the horse provided the drinks. We rode around the fields and villages outside of Moscow. There were few people around at that time. During the winters I would put Natalia on a horse and ski behind them. There were two basic problems with this: how to escape the clumps of snow churned by the horse's hooves that flew into my face, and how to deal with the sharp turns that Natalia sometimes took. In the latter case, I usually ended up with my face in the bushes.

One such excursion was especially memorable. Natalia was sitting on Veterok, her friend Julia sitting on the sneaky Don stallion, and I on Ilkush. At first we went slowly, but then switched to a light gallop. The sneaky bastard Don stallion felt right away that Julia was a novice, shook her and threw her off the saddle. While I was dealing

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<sup>106</sup> A horse of the Northwest Caucasuses origin.

<sup>107</sup> A horse of Turkish origin.

with this situation, Veterok went off with Natalia, bit down on the mouthpiece and hurried toward his mother's herd. She held on for as long as possible and tried to turn his head, but eventually fell off. The trainer always taught not to let go of the reins, so she held them tight and the horse stepped on her leg. The imprint of the horseshoe on her leg was there for over a year. The situation was dire: Natalia was laid up by the mother herd and Veterok was hopping on top of her screaming wildly and pulling toward the herd, and in the middle of the field Julia was trying to calm the stallion. Somehow I managed to collect all of them and the three of us, shattered, stumbled toward the stables, where the rest of the crew was already waiting with the bottles bought at our expense.

I was eventually promoted and received my own horse. This brought great joy, and a huge responsibility and everyday labor. At the same time, I began my pre-diploma apprenticeship with Igor Vasilyevich Kurchatov at the Laboratory of Measurements at the National Academy of Sciences. A choice had to be made: horses or science. I struggled and struggled, but chose science.

I ended up at LIPAN<sup>108</sup> after I.V. Kurchatov sent his deputy Igor Nikolaevich Golovin to our physics department to pick out students who could write their final diploma work at the institute. I was on the list of those chosen because of my high ranking then and because I had won competitions in high school. After an initial orientation, we were given information regarding medical care and the

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<sup>108</sup> An acronym for the Laboratory of Measurements at the National Science Academy.



daily routine. I have to state that despite the common belief that every other student was a snitch, my experience was very different – I did not deal with any government agencies nor was I aware of their presence. Of course as soon as I joined LIPAN, I was automatically on the government’s radar. Especially because of the high security and the role that L.P. Beria played as the leader of the projects between Minsredmash<sup>109</sup> and LIPAN, there was always a tight relationship with the authorities. I signed a contract to maintain loyalty and tried, as much as possible, to avoid going to restaurants, which was the sort of public place that would be frequented by both spies and security people. That was the kind of place where secrets leaked out. As the joke goes: “Why do the drivers at Minsredmash refrain from swearing? Answer: When they were hired they were told ‘If you repeat what you hear from your supervisors, you will become dust at a labor camp!’” With all the savageness of the regime, at the theoretical department – where I ended up – there reigned an atmosphere of intellectual freedom, like within a family, or on a completely different planet. So for over half a century I worked at the institute, and hope to conclude my career here. “To us the entire world is foreign; homeland is at Tsarskoe Selo<sup>110</sup>.”

The advisor assigned to me was Stalii Iosifovich Braginski – we became friends and worked together until he transferred to geophysics and then left for the United States. He gave me the following topic: “The stability of

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<sup>109</sup> Minsredmash, also Sredmash, is an acronym for the Ministry of Medium-duty and Special Machinery, also called Ministry of Special Machinery, which was responsible for the nuclear program of the Soviet Union.

<sup>110</sup> From the poem “October 19, 1825” by Alexander Pushkin.

Poiseuille current of conductive fluids with a longitudinal magnetic field.” The Poiseuille stability, even without the field, is a sophisticated problem. The common phrase was “Heisenberg<sup>111</sup> would be a respectable physicist if it weren’t for his mistaken theory of stability of the Poiseuille current.” In reality, he paved the correct way for demonstrating the asymptotic solution to this problem with the series of expansion parameters under the highest derivative. But Heisenberg did not succeed in completing the answer. This was done by a Chinese physicist by the name of Lee working in the United States during the war. His publications were available only at the library, and even then only in English. Besides the language, I had to dive into the finer details of mathematical physics, which came in very handy in the future. The magnetic field complicated the picture because it introduced Alfvén waves and resonance, but in principle these were merely technical difficulties, just like finding numerical solutions to differential equations using an Odhner Arithmometer, a mechanical pinwheel calculator. No one in the world has managed to solve this problem, though not that many have even tried. Years later, I bumped into one of these people in a Parisian metro stop. We met as I was looking for the road to Montmartre and he was returning home with his girlfriend after a heart surgery. He turned out to be a professor at Caltech in California, having just finished a book about the stability of the Poiseuille current, half of which consisted of my thesis work. This was highly surprising, but true. We spent a wonderful night wandering

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<sup>111</sup> A famous German physicist who made important contributions to the development of quantum physics.

around Montmartre – he turned out to be an exceptional host.

In addition to the problem posed to me by Braginski, I decided to investigate the influence of the magnetic field on the stability of spinning conductive fluids – this was inspired by my experiments with mercury. This problem was much simpler mathematically, yet much more significant for physics. It turns out that everything in the universe is spinning and everything conducts an electric current: planets (with their metal cores), stars, matter that falls into black holes, the dense stars (i.e. accretion discs), galaxies, and possibly the universe in its entirety. The instability I discovered in 1956 exists everywhere, as it turns out. Now, as I already remarked, this is my most cited article, although half a century later there is still no complete clarity on the subject. This shows that persistence and continuity are extremely useful in scientific pursuits, just like I.P. Pavlov described in his famous lectures on the mind. I still work on this unresolved problem whenever possible.

I did not have much interest in social activities at the time. One exception that I remember, however, was the organization of a lecture series modeled after a famous seminar held by P.L. Kapitsa, where he invited I.E. Tamm to talk about the work of Crick and Watson on the structure of DNA. N.V. Timofeev-Resovski<sup>112</sup> gave a lecture on genetics for the first time since he was out of exile in Ural. T.D. Lysenko was likewise invited but wisely declined<sup>113</sup>.

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<sup>112</sup> A prominent Soviet biologist and geneticist.

<sup>113</sup> Lysenko was the head of biology research in the Soviet Union under Stalin, but did not subscribe to the Mendeleev principles of genetics; his methodology was finally discredited in the 1960s.

Around this same time there were two notable lectures read at the Polytechnic Museum that I remember. The first one was a brilliant lecture by Paul Dirac<sup>114</sup> about the theory of the electron. He was asked, “What are these electrons?” Dirac answered that they are what transmits electric current. Then he was asked “Well, but what transmits electric current?” “Electrons” answered Dirac. The second lecture was by T.D. Lysenko himself which bordered on being schizophrenic and consisted of swears directed toward physicists. But this was already laughable, and not at all threatening.

The moment of job placement arrived<sup>115</sup>. Professor V.Yu. Gavrilov got ready to take our entire team to the Ural Mountains, to a newly organized nuclear center (the second after Sarov). This did not sit well with me – not for my career or my personal goals. V.Yu. Gavrilov tried to entice us, so they called each of us into a very secretive office at the Staromonetny Alley, demanding that we sign the job assignment order. They held us and did not allow us to leave. A few who could not handle the situation signed the order and ended up in the city of Snezhinsk<sup>116</sup>.

I tried to enroll in graduate studies at the physics department, but it was necessary to have a recommendation from the Party Committee. The deputy dean at the time, I.I. Ol’khovskii did not grant me such a recommendation on the grounds that I was not a member of the labor union. It was true that I stopped paying my union dues during earlier years of college because I resented that union activists did

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<sup>114</sup> A British physicist who contributed to the development of the theory of quantum mechanics.

<sup>115</sup> In the Soviet Union the graduates received mandatory job placement assignments.

<sup>116</sup> Both Sarov and Snezhinsk were so-called “closed cities” where the nuclear program was located.

not dedicate any effort to studying, but instead traveled around to some union-sponsored “Art Centers” on my hard-earned money. I was kicked out of the union, and everything was fine until Ol’khovski dug up this criminal offense. There was no choice but to write to I.V. Kurchatov, who offered to sponsor my graduate studies at LIPAN – a very favorable turn of events for me.

And so, my studies concluded, and I put my roots down at LIPAN with Natalia Arsenieva. My life path was charted.

At that time the Kurchatov Institute was known as LIPAN. I joined the department of theoretical physics, whose director was Mikhail Aleksandrovich Leontovich. The atmosphere was entirely free, and I became close with Roald Sagdeev and Sasha Vedenov<sup>117</sup>. One of our first collaborative projects, at the suggestion of Igor Nikolayevich Golovin, was to organize a series of lectures around the subject of plasma stability. After the acknowledgement that the “cavalry attack” tactic to create a controllable thermonuclear synthesis was failing, there was a great need to begin a systematic theoretical and experimental inquiry into plasma, as a novelty to physicists – a fourth state of matter. There are two well-established states of motion in continuum mechanics – laminar flow and turbulent flow. The latter is the most common. There exists a quasi-empirical understanding of its properties, although a whole theory, which could account for the

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<sup>117</sup> Both became prominent scientists.

phenomenon through foundational principles, still eludes researchers. Despite this shortcoming, we are able to design and build airplanes, rockets, long-distance pipelines, more or less describe and predict the weather, etc. Plasma has incomparably more levels of freedom; it consists of charged particles – electrons and ions, whose movement is responsible for the existence of electromagnetic fields and currents. These, in turn, are responsible for the movement of particles. Humanity faced an incredibly complex system, which brings a great meaning to the plasma research that is reaching far beyond the boundaries of practical necessity. Practical application is very important; it allows for specialization and depth when concrete problems have to be resolved. But without the understanding of basic principles one cannot progress far. We became the pioneers for creating a new field of science and, thanks to the very high intellectual caliber of our professors, above all Mikahil Aleksandrovich Leontovich, confidently acquired the title of trailblazers throughout the world. The lectures and the publications of experiments in the field of plasma stability in the journal “Advances of Physical Sciences”<sup>118</sup> introduced us to the research community.

The first international conference on plasma physics and controlled thermonuclear synthesis was being organized in Salzburg, Austria. The three of us – Roald, Sasha, and I – finished and turned in a report on the “quasi-linear theory of plasma turbulence.” It fell to me to give the presentation at the conference. Such was the atmosphere in a department where, by all accounts, I was the least senior person. To complete the paperwork for traveling outside of

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<sup>118</sup> Russian academic magazine “Uspekhi fizicheskikh nauk”.

the U.S.S.R., I had to be transferred very quickly from a graduate student to a junior research associate. At that time, my mind was constantly (24 hours a day, 7 days a week!) preoccupied with picturing turbulent plasma, two gases, waves and particles and the interactive resonance between the two. The Poiseuille instability of flux, which was the topic of my thesis work and which I already described, helped tremendously in this. At the end we were able to derive some very simple and beautiful equations. They depended in large part on the famous classical work by L.D. Landau and the so-called “Landau damping,” where he observed the interaction of one wave and a particle. We expanded this to describe the interaction of two gases – waves and particles. The moment of discovery, of realization, is one of the most enjoyable available to man! I always aimed to have as many of our friends and students live through this experience and the transformation of character to which this awakening leads.

The first trip abroad in those times was a momentous occasion: there was a talk at the Central Committee, a briefing by the authorities, and an assembly of the delegates. The leader of the delegates was an important official from the Committee on Nuclear Energy. The committee was just a facade for the secret Ministry of Special Machinery. The official would call us “busy bees” and made sure that we didn’t fly off. An official from the defense department of the Central Committee also monitored our behavior. But the true leaders remained Lev Andreevich Artsimovich and Mikhail Aleksandrovich

Leontovich, so the official spirit did not penetrate inside our delegation.

We arrived in Vienna. This was the first Western city that I saw. Everything was novel: parks, Mozart, Hofburg, the magnificent gothic St. Stephen's Cathedral, and the contrast between imperial luxury and modern buildings and architecture. Tan, gorgeous Austrian women, beautiful half-naked women on magazine covers, store displays, yogurt for breakfast, beer and wiener sausages... Today, imperial Vienna is not my favorite city in Europe, but I still have a special place for it as my first love.

At the Soviet office of the International Agency for Nuclear Energy we were greeted by V.M. Molotov. He acted like he was there in exile and had a confused mood, so he could not share anything interesting with us. Molotov looked at our delegation with a lot of suspicion. "All of you are very young..." he would say. "All are scientists," explained the supervisor from the government agency. We were put on a bus and taken to Salzburg, all the way on the other side of Austria. On the way we stopped over in Dachau. I had read many books about the cruelty of the Nazi regime and the concentration camps, and with the camps especially I was already familiar as described earlier in the book, so there are no especially vivid memories from this visit.

We arrived in Salzburg – Mozart's city. The conference started with an unexpected event. An American from San Diego, Bill Drummond, read his report that was very similar, although not as elegant and beautiful, as ours. This happens often in science when a significant



breakthrough is in the air. We met, introduced each other and became friends for many years.

But one of my closest friends in my life I met near a swimming pool over a round of beers. This was a tall, handsome guy from the very same San Diego – Al Trivelpiece. We have traversed our entire professional lives hand-in-hand (the reader will meet him many more times throughout this book). Overall, this conference expanded my circle of friends quite a bit. Martin Kruskal was one of them, who later came to Moscow with his wife. And Marshall Rosenbluth, who was a student of Enrico Fermi and one of the patriarchs (along with Boris Kadomtsev) of the field of plasma physics. Another one was Stirling Colgate, from the family that owns the famous toothpaste brand. And Alan Kolb, who later formed his own research company, and Norman Rostoker, and others were also there. Norman gave me a valuable piece of advice then. He said “In the U.S., you can buy a crappy thing for a lot of money, but it’s impossible to buy a good one for little money.”

I started to become interested in magneto-hydrodynamic (MHD) generators. In principle this is a very simple machine, first created all the way back by Michael Faraday<sup>119</sup>. But the limiting factor in implementation turned out to be the material of the walls. For the machine to work, the temperature of the gas flowing in the chambers has to reach 3,000-4,000 degrees Celsius. At the conference there was a very famous American physicist and engineer Arthur

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<sup>119</sup> An English physicist in the mid-19<sup>th</sup> century.

Kantrowitz. He worked for the Pentagon and was the best paid scientist in the U.S. He brought a murky report to the conference since his research on plasma physics was a side project. As a consequence, he had a very friendly attitude toward the rest of the participants who were much more engaged in plasma research. I asked him somewhat too bluntly “What material should we use to build the walls?” Of course he could not give me a direct answer due to government secrecy, but he did not want to avoid the question entirely. He replied enigmatically with a half-joke, “Use the wood.” This answer stuck in my head and at the end facilitated my creation of the only functioning type of MHD-generator in the world, a task that evaded him and others (more details on this later). Sometimes a simple phrase that’s understood by a scientist can influence the outcome far more than tons of intelligence data.

In those years most Americans suffered from a superiority complex. One dollar cost 40 shillings. There was an ongoing joke, “What does an ideal life for a scientist look like? It’s to have an American salary, a Japanese wife, a Chinese cook, and an English house. And what about a horrible life? It’s to have an American wife, an English cook, a Japanese house, and to live on a Chinese salary.” In this jovial atmosphere at the conference there was a scandal of cosmic proportions. A group of scientists from the Lawrence Livermore National Laboratory in the U.S. – which was created as a subversive move by Edward Teller<sup>120</sup> against Oppenheimer’s influence in his push to create a hydrogen bomb – in front of the media corps and

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<sup>120</sup> One of the original members of the Manhattan Project who created controversy when he testified against Oppenheimer at the latter scientist’s clearance hearing.

with great fanfare announced that a thermonuclear reaction was achieved in the so-called “open trap.” This contradicted both the theory and our experimental data. The job to find the discrepancies fell to Lev Andreevich Artsimovich. He turned the whole thing into a wonderful theatrical spectacle, I think mostly because of his love for theater, following the style of N.N. Evreinov. The problem was that the Americans observed an unusually long neutron impulse signal, which, in their opinion, meant that the plasma was unusually well stabilized in the trap. But Lev had lots of experience working with neutrons and already was very familiar with their ability to travel around the chamber and reflect off of obstacles, and therefore extend the time of the impulse signals. He waited for the culmination of the presentation delivered by the Americans and only then delivered the fatal blow à la Shakespeare. The Americans were caught off guard and at first began arguing against the idea on scientific grounds, but soon realized the futility. Then they employed the “heavy artillery.” The American delegation was headed by a retired admiral. He elevated the question to a political level. Lev was waiting precisely for this moment. He already hated the politicians at home and now there was an American one just asking for it! For his crowning number he harnessed all of his pent-up rage accumulated against the Central Committee of the Communist Party in the U.S.S.R. By this point the rest of us had befriended our American colleagues and were trying to assuage him. There was no point in trying! He was following purely Machiavellian principles: let them be fearful at first, love will come later.

By the end of the session, the members of the American delegation protested and as a symbol put up their feet on the backs of the chairs. But from that moment Lev became the unsurpassed leader in the thermonuclear field, once and forever. And by the way, this came in very handy when we formed a collaborative group of researchers from around the world to follow through on the Tokamak<sup>121</sup> idea (more on this later) and when we organized an international collaboration for building an experimental thermonuclear reactor (ITER).

The conference was concluded with a banquet. We were very limited on funds, and it was not because our daily allowance was so miserly. There were wives and children waiting at home who had no hope of seeing this magical world, and we wanted to acquaint them with it more than anything. Therefore, to save our money we ended up making up various tricks for our American colleagues. For example, we spent much time convincing Martin Kruskal that he was a genius, so he continued to run out for more wine. As a result, we all got fairly drunk. Alan Kolb and Bill Drummond got on the table and, hugging each other, fell straight onto the dishes below. But somehow, everyone got to their respective places fine. Our supervisor spent a long time visiting hotels and making sure we were all there. After that, during every talk at the Central Committee's office, I was told that it is better to drink at home. The next morning as the Americans slept peacefully in their hotels, we, God's slaves, were dragged through the entire country of Austria back to Vienna.

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<sup>121</sup> This is a device that concentrates plasma by using a magnetic field. The word is an acronym for **toroidal chamber with magnetic coils**.

My standing and collaboration with R. Sagdeev and A. Vedenov in the field of theoretical physics deepened, but I continued to be interested in magneto-hydrodynamics. Unexpectedly, I stumbled upon a collaborator in this – Sasha Vedenov. His education was based primarily on Landau’s work, so through Sasha’s influence I started to get ready for the “Theoretical Minimum<sup>122</sup>” exams and reached statistical physics. Sasha’s father-in-law, academician B.S. Stechkin, was very close with S.P. Korolev<sup>123</sup> and was familiar with the development of rocket technology – a top-secret project at the time. Boris Sergeevich Stechkin became interested in nuclear sources of energy to power satellites (this problem is still completely unresolved!). Sasha introduced us, and we began to discuss the possibility of using a liquid-metal MHD-generator for that purpose.

The key question was how to transform heat generated by the nuclear reactor into kinetic energy or into additional pressure of the flow of the liquid metal (live energy, as B.S. liked to say). The rest is obvious: compressibility is needed for the conversion, but liquid metal is not compressible. We came up with a steam emulsion – or mixing gas with the metal – and for a long time struggled with this. In short, nothing worked. However, I was introduced into the sphere of rocket technology, started reading lectures on magneto-hydrodynamics at the Moscow Aeronautical Institute, met

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<sup>122</sup> A series of exams on different aspects of theoretical physics developed by Landau. Their passage was required for admission, and in their 18 years of existence only 43 people have passed.

<sup>123</sup> Father of the Russian space program.

the deputy of V.N. Chelomei<sup>124</sup> named K.S. Alperovich, and the two of us began to run experiments. He was an exquisitely inventive individual.

The atmosphere at that time was euphoric – after the successful launch of Sputnik, the atomic and the rocket scientists felt nothing was impossible. Mstislav Vsevolodovich Keldysh became the President of the Soviet Academy of Sciences and the head Vice-President position was filled by Mikhail Dmitrievich Millionschikov from the Kurchatov Institute. Mikhail Dmitrievich was a very peculiar person: magnificent in his position but with a sensitive and easily bruised personality. He created an advisory board at the Academy of Sciences on the direct transformation of heat energy.

It was time to embark on something new at our Institute. On the one hand, there was N.N. Ponomarev-Stepnoi with thermo-electrical and (later) thermionic transformations of nuclear energy (nick-named “The Daisy”), and on the other hand, some interest was stirring around the MHD-generator, although I was the only one working on it at the Institute. I repeated my experiments with mercury for I.I. Kikoin, who very much enjoyed unusual demonstrations. M.D. Millionschikov noticed me and invited me to work for him. By that time there was a bit of a lull in thermonuclear research – as sometimes happens – and I gladly switched to a new field of research.

Meanwhile I continued to work with Mikhail Aleksandrovich Leontovich, who was an unusually well-rounded individual, and, although he was hardly interested in engineering, he did not object whatsoever to my

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<sup>124</sup> Leading Soviet designer of cruise missiles and ICBMs.

decision. There was only one obstacle – at the Institute everything was already “captured and doled out,” as they say. To start something new, even with strong support from the top, was very difficult.

Luckily, another reform period was soon underway. Khrushchev did not manage to dismantle the entire Academy of Sciences, but he did succeed in driving away the engineering department. Only much later in the 80s, and with much difficulty, was I able to reassemble some of the pieces. Among others, one laboratory left on its own, “The Magnetics Lab,” which had been established by Anatoli Petrovich Aleksandrov and specialized in studying demagnetization and means of uncovering submarines. The laboratory was situated in old wooden modular houses in the town of Krasnaia Pakhra, about 25 miles from Moscow. They offered to start my career there, and this is where I went to work for the next 15 years.

Now more about my family life. In my last years at the university, I spent the summers by the Nikolina Gora, where my aunt Vera, as I already wrote, gave French lessons and had a room. There I would also bring my Natalia and then, when I started to court her, her parents. Nearby was the horse-breeding stables, so there was plenty of gear for riding horses. But when the question of marriage came up, for a number of reasons Natalia’s mother voiced her opposition. The most trivial one was that Natalia was not yet 20 years old and looked much younger than that. But the main problem was that Natalia’s father periodically lived with his second family and the mother

used her daughter to keep the husband tied. I did not know any of this at the time and simply persevered. Sometimes the mother wouldn't unlock the door when I arrived, but love is no small potatoes. It all came to a halt when, on January 25<sup>th</sup>, I picked up Natalia and we went and signed the marriage papers at the district office without any fanfare. We celebrated the marriage at my apartment and spent our honeymoon in Nikolina Gora. Her parents did not attend the celebration.

At Nikolina Gora we rented a futon on the porch of a house and slept there. During the days we skied cross-country on the frozen Moscow River. It was hellishly cold with gusty winds. At the stables we rode horses. An old man, the owner of the house, entertained us with tall-tales. At the small grocery store in the village, as he bought rotten-looking herring, he would ask "Does eating this result in an easy death?" The only thing there was plenty of was black caviar. It was pretty inexpensive then.

I did not quarrel with my wife's parents. We moved into one of the rooms in their three-room apartment, using bookshelves to divide the room in half. On the other side lived Natalia's grandma – Maria Nikitichna Nechaeva. Natalia's parents were devoted Soviet intellectuals, so at the time I approached them with a critical view. Only later did I find out that they were among the first explorers of the Kolyma Gulf in the Arctic, who discovered the gold and diamond reserves of Siberia. Natalia's parents brought up their daughter to be a faithful Communist. It was not difficult for me to convert her to my side. That took about half a year, and then, adding to my own trouble, she became a militant dissident. The so-called "Noah's Ark" by



aunt Vera's place in the Frunzenskaia Embankment helped with this. During the winters I taught Natalia how to ice skate; we continued riding horses, and during the summers we headed over to Sudak on the Black Sea.

Our friends the Rambids lived in Sudak. They rented out a room from a Greek family. The house had a comfortable, homey atmosphere and so did the meals. We arrived with a tent, equipment for underwater fishing, and very limited funds. The tent had to be set up on the outskirts of a large dumpsite, and we ate at the local cheap cafeterias and visited the local beaches. This life got old very quickly. At the café they fed us endless amounts of chicken necks and we wondered how many necks can each chicken have? Dragging ourselves to the beach in the standing heat became very unpleasant. We hiked up to the "New World" – a historic plant owned by the Golitsyns<sup>125</sup> that produced champagne-style wine and that was situated on a nearby bay that was severely decimated by tourists. But just on the other side of a small hill there was a pristine bay, the so-called "Tzar's Beach." Whether any royalty visited the spot is an open question, but the place definitely had a royal feel to it – there was no civilization, no freshwater, and no tourists.

We would leave our tent unattended for the whole day, and from the champagne plant we obtained some cheap Brut for drinking and used the empty bottles to haul water from the well behind the mountain. We boiled noodles and fished for seafood. An especially valuable prize was gray mullets, but catching them was an arduous task. Mostly we caught gobies. The big fish hid in caves at the bottom. The

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<sup>125</sup> One of the highest noble family lines in Russian history.

trick was to dive 30-40 feet down and look into the cave. I was already out of air at 30 feet, which is why when I would bump into a kingfish or other large fish, I would leave my harpoon on the bottom and ascend to get more air. Then I would go back down and shoot, although a successful shot meant another dive into the cave to fetch the fish.

Despite the Crimean heat, it was cold in the water. The whole day was spent fishing. In the rocks on the shore we would catch crabs. As I recall those Crimean crabs taste best. They are smaller and tenderer than the ones from Kamchatka, which we would try later at the Kuril Islands<sup>126</sup>, yet bigger and more flavorful than the ones from Florida that we were served in Miami. It is difficult to catch large crabs; they tend to be very careful. Sometimes we would spot a one-clawed giant individual, and one day success came unexpectedly. When I caught a mullet fish and started to clean it, all of the local crabs came straight to me, including the one missing his limb. This one tried to push me away with his enormous claw. We devoured them all, which now actually weighs on my conscience a bit... We had already met them in person, and still ate them! But there is nothing to lament – human nature is made for hunting. So was our royal menu: fish, crabs, noodles and Brut champagne.

On our way back we stopped in Kuban<sup>127</sup> to visit one of Natalia's friends. The friend's father was a high school physics teacher. They greeted us very warmly. After all, I graduated with a degree in physics and now was working at

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<sup>126</sup> A series of islands that run from the southern coast of Kamchatka to the northern shores of Japan.

<sup>127</sup> A region in southeastern Russia

a secret research lab. For the occasion, he opened wonderful liqueurs and wines, and the mother brought out her sour cream that had a spoon standing straight up in it, and other treasures from the region. The consequences, needless to say, were severe. Predictably, he and I spent the entire night getting closer to death by drinking more and more, and in the morning we regretted that we did not die the day before. It was embarrassing to be in this condition in front of our ladies, but they soon forgave us. All of us traveled around to see the local Cossack villages and to visit the bustling markets. For the first time I realized the scale and consequences of the Bolshevik-led genocide of the Cossacks that was carried out under the direct command of V.I. Lenin and Y. M. Sverdlov<sup>128</sup>.

In Moscow my job was waiting, as well as Natalia's classes, equestrian riding, and ice-skating in Gorky Park. At that time, I rode proudly on Norwegian horses and taught her as well. There were also cultural activities, thanks to the ongoing Thaw Time. Although the situation was quite awkward, as was best described by B. Pasternak.

The cult of personality is stained,  
But after forty years, the cult  
Of gray monotony and disdain  
Persists like in the days of old.

Each coming day appears lackluster,  
Until it's truly hard to bear,  
It brings but photographic clusters

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<sup>128</sup> Yakov Sverdlov (1885 — 1919) was a Bolshevik party leader and an official of the Russian Soviet Republic.

Of pig-like and inhuman stares.

The cult of narrow-minded thinking  
Is likewise cherished and extolled,  
And people shoot themselves, while drinking,  
Unable to sustain it all.<sup>129</sup>

Such works were published in A.I. Solzhenitsyn's "One Day in the Life of Ivan Denisovich," "Matryona's Home," and "For Whom the Bell Tolls" by Ernest Hemingway. We started going to the swimming pool to learn how to scuba dive. But the spring brought a new phase to our lives. It's rare that anyone plans their first child. And we didn't plan. Natalia started experiencing pain. We took her to the hospital, fearing an ectopic pregnancy. She was completely convinced that I had ruined her life. It's worth noting that she was studying geology and had already gone on an expedition to the Far East with her cousin and was planning on going again. Geology interested her because of nature, not as a scientific field. And as it turned out, she is happiest in a forest surrounded by animals and children. A blood test showed that she had syphilis. Imagine her shock! Thank God, at the venereal clinic two old experienced Jewish grandmas-doctors – after a quick interview and examination – determined that it was toxemia of pregnancy, and not syphilis (Lenin's case, on the other hand, is still being debated<sup>130</sup>)...

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<sup>129</sup> Poem by Boris Pasternak (1956). Translation by Andrey Kneller (2011).

<sup>130</sup> It has been speculated that Lenin died of syphilis, not of a stroke as the official version claims.

In the spring we went to Nikolina Gora to visit aunt Vera. We were not allowed to go by bus since the shaking was deemed dangerous. So along with my brother Vova we took the train to Zvenigorod and sailed down the Moscow River on a rubber boat toward the Nikolina Gora and the exact spot where, rumor has it, B.N. Yeltsin was thrown into the river<sup>131</sup>. This was a wonderful trip; the nightingales were singing the whole way. At that time it was still great to collect wild strawberries and to go mushroom picking at the Nikolina Gora. We would take long walks and Natalia's pregnancy progressed very smoothly. In December Natalia gave birth to our son, Vasia. All of our three children were born during the same week in December, albeit in different years. We called this phenomenon the "March Cat Effect." As soon as we brought Vasia home he caught pneumonia. I made him compresses made from mustard-soaked sheets<sup>132</sup>, which were long enough to envelop him almost completely. Luckily, we found a doctor – Tumarkin – who treated children of old intelligentsia and who resembled an ancient Jewish prophet. We fell into a routine usual for that period, concerned with obtaining diapers, butter, baby clothes, etc. Natalia's breast milk was always in abundance, although this resulted in mastitis, so I learned how to give her medicinal shots and did it for Vasia as well.

Natalia returned to her studies at the university, so we had to find a nanny. During breaks she would run over to the student dormitories where I would bring Vasia to nurse.

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<sup>131</sup> On September 28, 1989, Yeltsin was involved in a curious and much-publicized incident where he either was pushed or fell from a bridge into a small river.

<sup>132</sup> A traditional folk remedy.

Our stipends were inadequate, so we had to always rely on another source of money. Sasha Vedenov and I found such a source in the All-Union Institute for Scientific and Technical Information. Sasha organized the new weekly publication of the journal “Express Information on Plasma Physics.” He became the editor, and I the only reviewer. So every week, on Thursdays, I would read all the leading journals on the topic in English (there was nothing worthwhile in other languages) and wrote all the articles during the night. Of course, this was not a straightforward translation, but rather a brief analytical resume. However, in just one month, a subscriber paying the meager fee could receive a summary of all the slightly notable developments in the field, sent to any corner of the Soviet Union. Is there such a service now with the advent of the Internet? Together with the money from lecturing and in addition to the stipend, we had enough for the family, and after one year I even bought a humpy Zaporozhets<sup>133</sup>.

Life in Moscow, despite the tremendous help from Maria Nikitichna – Natalia’s grandma – was difficult for us; so after a year, after Natalia stopped nursing Vasia, we moved in with her other grandma – Varvara Vasilievna – into her own house in Pushkino. There we fixed up the terrace and lived on the watchmen’s regime: one week I would stay at home, another week Natalia would, with the help of a hired nanny (but every new nanny was worse than the previous one, I have to say).

I met and visited Varvara Vasilievna at the very beginning of my courtship with Natalia and developed a lot

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<sup>133</sup> The cheapest Soviet-era car with an air-cooled 20 to 27 hp engine in rear.

of respect for her. When she had guests over, she immediately would find something for each to do – she just could not tolerate seeing someone idling without a job. Natalia’s grandfather, Aleksandr Nikolaevich Arseniev, graduated from Sorbonne, and then studied in Berlin with S.P. Botkin<sup>134</sup>, after which he went to a village and became a rural doctor for the rest of his life. Many times he was offered a more attractive career, but he was very committed. His wife, Varvara Vasilievna Bibikova, supported him fully and became a teacher at the village school. The grandfather knew three generations of his patients personally and would rise in the middle of the night in blizzards or rainstorms, ready his horse, and set out to deliver babies, operate on inflamed appendices or sew up yet another open wound. These were salt-of-the-earth Russian people with great European education, who became the source of culture, morality and kindness. I am not sure if this phenomenon exists in other countries, or if it will ever be repeated here. Aleksandr Nikolaevich had unending knowledge and a love for nature, and he instilled that love in Natalia. Her great-grandfather also chose the medical profession and died in the War near Plovdiv during the liberation of Bulgaria. His name is inscribed into the “Doctors’ Statue” in Sofia – for every Bulgarian person alive then, one Russian soldier gave his life. Another Arseniev from their family died near Shipka during that war. In all the history of war, was there any other fight that was so just and noble?

In Natalia’s family, issues related to genealogy were not discussed. The Soviet regime destroyed the noble

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<sup>134</sup> A very prominent Russian medic who worked in the latter half of the 19<sup>th</sup> century.

class's interest in their own roots, and it became an almost rude topic. Yet the lineage of the Arsenievs traces back to an ancient noble family. Documented evidence begins with Aslan-mirza Chelebey who in 1389 entered the service of Dmitrii Donskoi<sup>135</sup> from the Golden Horde, accepted the Orthodox faith and adopted the name of Procopiy (Prokofiy). His son, Arseny Prokofievich, received a nickname Isup (Yusup). From him, the Arseniev and Yusupov family trees began. At that time, the Russian nobility absorbed and digested the Horde aristocracy, especially after Islam became the state religion of the Horde.

Their family line is listed as nobility from Tula. Daria Arsenieva was the wife of his Highness, Prince Menshikov, and her hunchbacked sister Varvara was the closest advisor of Peter The Great on international matters. One of the Arsenievs was the grandmother of M. Yu. Lermontov<sup>136</sup> and others were important historical figures as well. The Bibikovs were likewise a famous family throughout Russian history. Their ancestor, Zhidomir-mirza, a relative of the khans of the Blue Horde, left the Blue Horde to Tver in 1300. His son Dmitry was baptized and became a nobleman of Tver. He wore the nickname Bibik, and received from Ivan III estates in the Novgorod land. From him the Bibikov family began, many of whom were governors, governors-general, aides to tsars and tsarinas, including the special confidant of Peter the Great.

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<sup>135</sup> Dmitry Donskoy (1350 - 1389), son of Ivan II, reigned as the Prince of Moscow from 1359 and Grand Prince of Vladimir from 1363 to his death.

<sup>136</sup> Mikhail Yuryevich Lermontov (1814 – 1841), a Russian Romantic writer, poet and painter, became the most important Russian poet after Alexander Pushkin's death in 1837. He is considered the supreme poet of Russian literature side by side with Pushkin and the greatest figure of Russian Romanticism.



A.S. Pushkin emphasizes the general-in-chief Alexander Ilich Bibikov among the leading figures of Catherine the Great. He distinguished himself in the Seven Years' War, the suppression of the Polish uprising and of the Pugachev rebellion<sup>137</sup>. Under his leadership Alexander Suvorov began his career. Catherine asked A.I. Bibikov to chair the committee on drafting the Code of 1767, so he was like a secretary of Catherine's analogue to the modern Civic Chamber.

In the War of 1812 at the Battle of Borodino<sup>138</sup>, Dmitry Gavrilovich Bibikov was distinguished: a cannon ball severed his right hand, but he did not leave the battlefield. This earned him a special respect from his contemporaries and the Emperor. After the war, he served subsequently as the vice-governor of Vladimir, Saratov and Moscow; in 1837 he became the military governor of Kiev; since 1848 he was a member of the State Council, and since 1852 he served as the Minister of the Interior. Bibikovs also intermarried with the Golenishchev-Kutuzovs<sup>139</sup>. Many of them were representatives in the Russian Duma and had posts in the Moscow administration. They, in particular, have legal rights to the historic Bibikov house in old Moscow on Prechistenka, in which Denis Davydov<sup>140</sup> once lived.

All of this I learned much later. There were no documents in the house; I found only a pre-war journal with a mellifluous ode by the famous bard Jhambul

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<sup>137</sup> Yemelyan Pugachev (1742 – 1775) was a pretender to the Russian throne who led a great Cossack insurrection during the reign of Catherine II.

<sup>138</sup> A battle against French invaders in 1812.

<sup>139</sup> Another very prominent aristocratic Russian family. General Mikhail Golenishchev-Kutuzov defeated Napoleon's army.

<sup>140</sup> Denis Davydov (1784 – 1839) was a Russian soldier-poet of the Napoleonic Wars.

praising Stalin-era “iron” People’s Commissar N.I. Ezhov<sup>141</sup>.

We lived in Pushkin almost a year. Due to my new position in Krasnaia Pakhra at the end of 1961, we were issued a two-bedroom “Khrushchev-style” apartment<sup>142</sup> in a recently constructed building in town. This was our first apartment not shared with other people. The toilet was in the bathroom<sup>143</sup>, there was a wood-fired water heater, and in the kitchen there was a wood stove, and through the cracks in the floor a rat would steal Vasia’s toys. Nonetheless we were overjoyed and celebrated the house warming with the entire crew from the theoretical group, including Mikhail Aleksandrovich Leontovich. Close to the building was a woodshed, and beautiful white porcini mushrooms grew around it. So began our time at the Krasnaia Pakhra.

The end of the 50s and the beginning of the 60s was a time of unbridled enthusiasm and romanticism in nuclear and rocket engineering. So much was invented and immediately turned into projects, prototypes, or demos! Most of the progress took place in the U.S.S.R. and U.S.A., plus a bit in Europe. There was no hint of today’s bureaucracy that stops every progressive idea in its tracks. There was an informal network of scientists, designers, engineers, plant technicians and political leaders from the

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<sup>141</sup> Nikolai Ezhov (1895 – 1940) was a senior figure in the NKVD (the Soviet secret police) under Joseph Stalin during the period of the Great Purge.

<sup>142</sup> Built during the boom construction era during Khrushchev. The apartments were in very modest five-story block-shaped concrete buildings.

<sup>143</sup> Usually the two were separated in Soviet apartments; toilets in bathrooms were considered low standard.

Politburo, and all collaborated in trust and practically without any tension. As a result, in the shortest time span, models of technological advancement were created that defined the course of the rest of the 20<sup>th</sup> century and the beginning of the 21<sup>st</sup>: the T-34<sup>144</sup>, VVER-400<sup>145</sup>, APL<sup>146</sup>, TU-104<sup>147</sup>, RD-3M<sup>148</sup>, the Royal Seven<sup>149</sup>, the M-20<sup>150</sup>, the satellite and the Tokamak. It was truly a romantic era. But romanticism carries with it the danger of regression. Plus, the Cold War began. Since the war was “cold,” there was no trying out the weapons in battle, and the world gradually embraced the virtual realm of nuclear winter and star wars.

The end of the 50s witnessed the development and testing of nuclear rockets, airplanes and many other technological wonders. Soon there came research into high-beam and laser space weaponry. American militarism found a great companion in the Soviet super-secretiveness. It was in this atmosphere that I arrived at the Magnetics laboratory. It was transferred to Sredmash as a department of the Kurchatov Institute. The director of the lab was a very pleasant captain of the first order named Viktor Dmitrievich Panchenko, and I found myself in a semi-formal position of an *éminence grise*. In the future I became quite comfortable with that role. The main goal was to develop a magneto-hydrodynamic converter of heat energy to use in any nuclear electric plant. However, right from the start a fundamental problem was evident. The core

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<sup>144</sup> Famous Soviet medium-sized tank during WWII.

<sup>145</sup> A pressurized water reactor used in nuclear power plants.

<sup>146</sup> A nuclear submarine.

<sup>147</sup> A first Soviet commercial jet airplane.

<sup>148</sup> A jet engine.

<sup>149</sup> The first intercontinental ballistic missile.

<sup>150</sup> A heavy-duty bomber plane.

of the MHD-generator had to be conductive to electricity, and the core of nuclear reactors was made up of fluid or gas (steam). Fluid is conductive if it is made of liquid metal, but this metal cannot be compressed. It was exactly the same problem that I had worked on with Stechkin and Alperovich. Gases can conduct electricity given that they are heated to a very high temperature, but this is in direct contradiction with the nuclear reactor, because its combustible elements (as a result of a chain reaction) collect highly reactive fission by-products, and those need to be stored somehow until the next refueling. With high temperatures there were no suitable materials to build impervious walls. But there was a way out: a fluorescent bulb remains cool to the touch even though electricity is flowing through it. This happens because the electrons are heated in the bulb by the electricity itself and reach much higher temperatures than the gas. Was it possible to do the same with the MHD-generator? The most prominent scientists who spent their lives working on gas discharges categorically answered “No!” Following Platonov<sup>151</sup>, I considered all of this a “deafening ignorance” of professors, since at that time I did not hold a Ph.D. nor was I a professor.

At the laboratory in Pakhra a group started forming from the cohort of students in the class just younger than mine: Yura Volkov, Volodia Golubev, and Zhora Kasabov. During our years at the university we played gop-dop<sup>152</sup>

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<sup>151</sup> A Soviet-era author (1899-1951), who had a very skeptical tone.

<sup>152</sup> A popular game among students which involved guessing who is holding a coin.

and I usually won. We had to create a new science about plasma with hot electrons in a magnetic field – the theory and experimental science, of course, was not of the same magnitude as the field of thermonuclear plasma, yet it was not trivial. We had to teach the basics to the newly hired members and to those who remained in the laboratory, and to convert all of the work into pilot test equipment. And this is what we accomplished, independently and ahead of everyone else on the planet. At first we were not acquainted with our competitors in the U.S. and Europe, but when we did meet, we got to know each other, collaborated and formed friendships. Atomic technology did not proceed according to the so-called “innovative” path, but settled for water vapor, and thank God! In such a global and dangerous enterprise as nuclear energy, innovations, of course, had to be tried but only slowly and carefully. We did not know at the time how everything would end, and so we proceeded the whole way toward very concrete goals, which, in my opinion, is the correct approach and is one of the traditions at the Kurchatov Institute. Many were much more ambitious and had the right tools, but they strayed from the course prematurely.

At the Magnetics laboratory (“The Mag Lab”), we began to simultaneously establish an experimental basis to carry out trials, develop theory, and build a systematic research environment, all for constructing and building two major experimental installations while designing and erecting the buildings to house them. We began working with large production organizations such as the Research Institute of Electro-Physics Equipment, and the N.A. Dollezhal Research and Development Institute of Power

Engineering. A distinct group formed, and we acquired a certain characteristic “Kurchatov” work style. Then a serious competitor appeared – the Institute for High Temperatures, which was developing an MHD-generator for regular, not nuclear, energy.

On my next work trip abroad I went with the academician Aleksandr Efimovich Sheindlin. At that time he and another academician Vladimir Alekseevich Kirilin were busy setting up the IVT<sup>153</sup> and promoting the development of the MHD-generators. V.A. Kirillin was the director of the science branch of the Party’s Central Committee, and I was in a completely different weight class, as a junior scientist. Similar programs were starting up at the Massachusetts Institute of Technology, at the AVCO Everett Aeronautical Research laboratory by Arthur Kantrowitz, in England at the Electrotechnical laboratory in Leatherhead at a company named “Parsons”, and in Germany at the Max Planck research institute and other laboratories. The conference on the topic was the first world-class forum dedicated to this new branch of science and technology. At the session, a professor from MIT presented a very ambitious report, which, among other things, revealed that Professor Jack Kerrebrock had proven the stability of MHD-currents. The next report was mine, where I was proving just the opposite. In the end, Jack Kerrebrock (who was not asserting such a thing at all) and I became great friends and still work on collaborative projects.

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<sup>153</sup> Institute of high temperatures of the Academy of Sciences.

At the end of the conference it was suggested that an advisory body for the study of heat transformation should be created at the International Atomic Energy Agency (IAEA) in Vienna. We worked together successfully for 10 years. This advisory body became the prototype for the creation of a similar advisory board on the development of controllable thermonuclear synthesis that I created together with an American colleague, Amasa Bishop, in 1971. This step laid the groundwork for the creation of the International Thermonuclear Experimental Reactor (ITER). Plus, concurrently, I oversaw the successful construction of an experimental research center in Leatherhead and built a similar one in Pakhra. All together, the Magnetics Laboratory in Pakhra was transformed into a state-of-the-art center – both by Soviet and international standards.

Within the span of 5-6 years, foundational principles of physics were developed for the magneto-hydrodynamics of plasma with hot electrons, as well as experimental methods for their derivation and research. The additive used for ionization in such plasma is cesium vapor, and the materials used for construction are oxides of aluminum and leucosapphires. I would like to mention here the contribution of a great craftsman – Viktor Nikolaevich Litvinov, who transferred to us from the Institute for Physical Problems, and who directed the experimental shops and quickly mastered the technologies that were still new in our country.

Regarding the MHD-generator – it turned out that the main idea was beautifully simple and very elegant. Imagine a ceramic skillet covered but for a small crevice with a same-sized lid. At the center of the skillet there is an

opening; the gas is coming in through the crevice between the skillet and the lid and then flows along the radius in all directions, perpendicular to the uniform magnetic field, which is created by two Helmholtz coils wound around the skillet. The electrons in this type of a system are moving across the direction of the speed vector, moving on the circumference. They heat themselves up from the friction with gas, in the process of ionization of the cesium vapors. The cesium ions in turn are attracted by the gas and create useful current (known as the Hall current). The only trouble is that the electrons in the magnetic field move as an incompressible fluid and, if the ionization is non-uniform, they acquire a “hilly” pattern, like water on top of a bumpy surface. As a result the voltage and the heating of the electrons becomes uneven, prompting further non-uniform ionization, and this, in turn, amplifies the non-uniformity of the current. This is exactly the mechanism by which turbulence is created. When under a uniform flow, the Hall current is growing with the growth in the magnetic field. However, under non-uniform conditions, the growth is saturated. We predicted this effect not only theoretically, but also traced the predicted structure in plasma with electron-optical converters. The moment when we witnessed the predicted results in person was another moment of enlightenment that is only rarely awarded to the scientist by nature, and which makes the pursuit of science worthwhile. The nuclear power industry has not advanced enough to use these results, but with its worldwide development, I hope they will come in handy at some point. It’s just the idea itself that is so striking.



We were surrounded by good science through our activities, plus we also formed a very nice international scientific brotherhood between the Soviet, French, German, Italian, Japanese and American physicists and engineers. There was no tourism per se, but I managed to travel to the majority of the capitals and other large cities for conferences and for work. There was access to world-class art forms, such as impressionism and other -isms, and to free literature.

My venture into reading in English began with William Shirer's book *The Rise and Fall of the Third Reich*. I ended up in the hospital with the diagnosis of a relapsing fever. Apparently this was an attack of appendicitis, but since I just returned from abroad, I was stashed in the unit for infectious diseases located on Sokolinaia Gora. In my room were patients with hepatitis and cirrhosis of the liver due to excessive drinking. Eventually, I was informed that there had been no case of relapsing fever in Moscow since WWII, but the diagnosis couldn't be officially lifted until the next relapse.

My wife started conjuring up ways to secure my release. Meanwhile one of my graduate students from Uzbekistan – whom I helped a great deal with his dissertation – sent to Moscow a truck full of melons and called my mother-in-law to help him sell the goods. She mostly spent time lying around on the couch reading Agatha Christie. What happened with this truck therefore is not precisely known, but my wife managed to bring me one enormous melon. We cracked it open and discarded the rotten insides out the window. Right away the area was

swarmed with dung flies, which were also ubiquitous in the bathroom, which could hardly be used because of the ever-present uncontrollable deluge in there. Before sleep all the patients were given some kind of “calming” mix. The alcoholic kept a little bottle of liquor hidden in a drawer. He exchanged the contents of the medical vials with the liquor and also recommended that we drink for disinfection. And this was the way we lived... There was plenty of free time, so I started on the Shirer book.

My wife managed to get me transferred to the hospital at the Academy. There, they couldn't figure out the correct diagnosis either. I remember one professor interrogated me about everyone I had contact with. I answered “Also with my mother-in-law but she didn't get sick,” and he remarked, “Yes, those mother-in-laws can be very resilient.” They tried to take away my things to disinfect them, but my wife won that battle. Finally I was released, but I'd already had time to finish the book and so I started reading thick books in English.

My next trip for work was to the United States. Oleg Belotserkovski was scheduled to travel there on an exchange program (he is now an academician), but he had some issues at home and Millionschikov sent me instead. I flew to New York alone, without any guides, without any practice in English, and practically without any preparation at all. At the airport an employee from the U.S. State Department named Fima Haimson met me. He gave me an American Express credit card, the schedule for the trip and asked me to follow it closely. Before my departure from

Moscow I had to suggest a travel plan. In it I wrote that I wanted to visit the following cities: New York (to see the Hilbert lab), Princeton (for the physics laboratory on plasma run by Lyman Spitzer), Boston (to see MIT), Chicago (to see the University of Chicago), Los Alamos, San Diego (for General Atomics), back to New York, and then back to Moscow. I was already acquainted from conferences with the physicists working in these labs. So, within the course of a month, I traveled around all of America, learning conversational English (which I call the cheap American version of the language, one that I still use today) and established a number of valuable contacts. I'll describe one.

At MIT in Boston, my host was Bill Jackson. We later worked together for a while on MHD-generators. Besides showing me around campus, he was supposed to demonstrate to me the advantages of the American way of life and the American political system. After a long lecture on the topic at a restaurant, he asked me to share my impression of the United States so far. He caught me off guard, there was no time to think, so I blurted out, "Too many households have guns." A month later, President Kennedy was shot in Dallas. Bill started regarding me as a Wolf Messing reincarnate<sup>154</sup>. In reality what happened is that before dinner I found myself at a store to buy my son a toy gun, and the clerk suggested, "Why buy a toy? Get a real one for almost the same price".

I visited Disneyland and the open zoo in San Diego. It was too bad that I was there alone without my family. At the time I thought there was no hope for them to experience

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<sup>154</sup> A famous "mind-reader" in the U.S.S.R.

any of this. Luckily, this time I was mistaken. During my trip I purchased scuba and underwater fishing gear for my wife and I. This opened underwater fishing for us across all the cooler waters of the U.S.S.R. – from the White to the Black Seas, Lake Baikal, Kuril, Solovki, and Pleshcheevo Lake. I also acquired some books and magazines. I lost touch with reality over the month living in the U.S. Later I had problems with these books and magazines back in Moscow.

I will use this opportunity to tell about a few more of my trips abroad for work. There was a symposium about MHD-generators in Tullahoma, Tennessee. We had a whole crew going headed by A.E. Sheindlin. At the airport we spotted a Chinese guy mumbling something along the lines of “symposium.” A.E., confident as always, declared, “This is us.” But he didn’t know much English, just like the rest of us. We climbed aboard the bus, it stopped at some hotel, and we piled into the registration queue. No one looked familiar. When our turn came we showed our passports. There was a speechless moment... It turned out we had accidentally arrived at a NATO symposium, where the topic was on strengthening the collaborative efforts between the U.S. and western Germany on rocket technologies. The hosts very quickly fetched us cabs and sent us on our merry way to the correct place.

One evening we wanted to celebrate our trip. But we were told that Tennessee is a dry state. What to do? We went up to a policeman. He pointed out a store and explained how to approach it and receive the liquor through

a small doggy-door out back. So what's next, we asked? He answered that from there, drinking is allowed only at a private club. We had to drive 80 miles to a club called "Magnolia". And really, what we did find was a club in a little wooden cottage, where two ladies whose faces still had traces of past beauty met us. I became an honorary member of the club, and perhaps, still remain one to this day. As we danced I told my partner that I was from Moscow.

--What state is that in?

--It's not in a state, it's in the U.S.S.R.

--And where is this U.S.S.R.?

Those lucky people... Eventually it was time to go back to our hotel and it turned out that I was the most sober. I sat at the wheel. For the first time I was in an American vehicle with an automatic transmission and power-assisted brakes. The road was so narrow that it seemed like the sides of our car were hanging off the concrete strip. There was a car going the other way. It miraculously passed by. I drove onto the highway and – to my horror – everyone else was heading straight toward us! I slammed on the brakes. Some of the group fell under the dashboard, the rest flew into the backs of the front seats. Everyone sobered up immediately and we got back to the hotel without further adventures. In Moscow someone reported the incident to the authorities (I think I have a good guess of who it was) and I got a long lecture about how drinking should be done at home.

But more is still ahead. In the morning, A.E. started to arrange for us to see the equipment. This was a delicate matter, and a Russian professor from the local university

was invited. He listened to both sides and advised “One time Witte<sup>155</sup> sent a gentleman to Siberia, and during the farewell said the following: ‘The farther you go, the quieter you will be.’” So we decided to go to Washington. As we approached the airport, we were told that we could not go further into the city. “Is there a war going on?” we asked. “Nearly” was the reply. It turned out that right near Tullahoma, in Memphis, Doctor Martin Luther King Jr. was assassinated. So we stayed at the Marriott in a suburb. In the morning, Yura Chernilin – the deputy general director for the International Atomic Energy Agency that was overseeing our Council – teamed up with me to try and use our administrative positions to get into the city. No luck. We complained, saying “Not only is the KGB following us, now the FBI is as well. Is this a free country or not?” So we got through. The city was reminiscent of Stalingrad. Soldiers were positioned on the manicured lawns. They were weighed down with ubiquitous ammunition and in this heat had trouble moving. Several blocks in a row were steamed with tear gas. Store windows were broken. A sofa was sticking half-way through one window. A sweaty black man walked with two television sets on his shoulders. All the stores and cafes were shut down. Some houses were on fire. Old automobiles rolled down the streets, occupied with locals waiving empty bottles and singing. A large truck in the middle of the street served as the food spot for the National Guard troops, doling out sandwiches and coca-cola. I offered to snatch a couple of sandwiches for ourselves, but Yura, as an international official, did not want to risk a diplomatic

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<sup>155</sup> An influential pre-Soviet Russian policy-maker.

incident. Nonetheless, I made my way to the queue and received two sandwiches. As we were taking pictures in front of the Capitol building, several black kids approached us demanding money. Of course, from the Russians there was hardly any money to be had (at that time especially)! The radio announced the start of the curfew and we made our way back to the hotel to watch the rest of the evening's news unfold on TV. In the words of F.I. Tyutchev, "Blessed be those who visit our world at its crucial, fateful moments!"

My next work trip was to Pasadena and the Jet Propulsion Laboratory, together with Mikhail Dmitrievich Millionschikov. He was the Vice-President of the Academy, one of the most respected scientists in the country, and a member of the Pugwash Committee of Scientists<sup>156</sup>. His task was to conduct talks with the administration. On the way we stopped off in Montreal to see Expo-67, where Millionschikov was the chair of our committee. We flew on a TU-144<sup>157</sup> to Montreal. M.D. had his own separate cabin, so the three of us – M.D, A.E. Sheindlin, and I – took on the task of finishing our entire provision of cognac. We got to the exhibit pretty tipsy and the presentations appeared in my eyes, again, to be on split screens. In the majestic pavilion I bumped into a couple of familiar faces from the rocket engineering department who spent their time assembling secret equipment (like the familiar PKIDD valves that were not only highly secret but also were rare and in high demand in the U.S.S.R.).

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<sup>156</sup> Pugwash Conferences on Science, founded in 1957, is an international organization that brings together scholars and public figures to work toward reducing the danger of armed conflict and to seek solutions to global security threats.

<sup>157</sup> A Soviet supersonic civilian plane.

Then we flew to Los Angeles and drove over to Pasadena. The symposium started in two hours, and my presentation was the second on the agenda. M.D. Millionschikov suggested that we finish off another bottle and then make our way to the symposium. The three of us shared in the fun. A.E. Sheindlin curled up to go to sleep and the remaining two of us walked over to the conference along Pasadena's empty streets, where hardly any sidewalks existed. Americans drive even to the nearest stores. Closer to the laboratory, someone recognized Millionschikov. My turn came to present and I did in my own American "jargon". M.D. sat in the audience and could hardly hold in his laughter – he was taking English classes back in Moscow. We were given a warm reception at the laboratory in Pasadena and at Caltech – the workplace of Theodore von Kármán<sup>158</sup>. As M.D. and I discussed the results of the sessions we realized that the MHD-method had little prospective value for nuclear power plants. Other applications for it had to be sought.

The period of unbridled enthusiasm was coming to an end. A plasma-based reactor was one of the most exotic projects conceived. It was being pursued at the Institute for Thermal Processes, whose director was the President of the Soviet Academy of Sciences, academician Mstislav Vsevolodovich Keldysh. The Americans had a parallel project to develop a plasma reactor (Scheme B). It was being developed in complete secrecy. Our specific work was headed by Vitalii Mikhailovich Ievlev. His training was in engineering and mathematics, and he put the project

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<sup>158</sup> A famous Hungarian-American physicist. The American Society of Civil Engineers has awarded the Theodore von Karman Medal since 1960.



on solid footing. Many of my fellow students from the university worked on the project. The main idea was to separate the region of nuclear combustion from the flow of cooling gas and to transform the heat by radiation.

Attempts to simply smooth the flow of the fluid to create laminar streams proved to be in vain. Vitalii Mikhailovich suggested that we use a strong magnetic field and a current along the field to hold the hot plasma of the uranium inside the hollow stream. I.V. Kurchatov sent me to discuss this idea.

V.M. – in the best traditions of MSU's Mechanics and Mathematics department – had filled the entire blackboard with integrals and correlation functions. I recalled my experience with mercury and showed on my fingers how the current will coil into a spiral pathway and the whole configuration will crumble regardless of the strength of the magnetic field. Propping up his chin on his hand, M.V. Keldysh sat in his chair silently. V.M. Ievlev proved to be more convincing at the time and enormous arrangements were put into place to build a reactor based on his ideas over the next few years. He was a professor after all, and soon after was elected for membership in the Academy of Sciences, and I was simply a junior research associate. This program existed for a long time but at some point it died on its own, just like so many other projects undertaken in the romantic 50s. So this path met a dead end as well.

The Institute for High Temperatures had a project to use MHD-generators with byproducts of burned organic materials. The decision to involve us came from two different directions. First of all, Aleksandr Mikhailovich Prokhorov, to spite his former student and now competitor

Nikolai Gennadievich Basov, and together with academician A.A. Raspletin, initiated the development of laser weapons aimed at low-flying targets. Right around this time lasers with neodymium glass and flash lamp excitation began to make an appearance. A.M. Prokhorov turned to M.D. Millionschikov with a proposal to develop electrical pulse generators. M.D. assigned the task to me.

At Pakhra we tried out a series of designs and decided on a pulse MHD-generator with inductive energy storage. Here I remembered the idea of wooden walls. So the design incorporated the following: a powerful solid-fuel rocket (the byproducts of the burning process under temperatures exceeding 7,000 degrees Fahrenheit are sped up in the jet nozzle to over Mach 2 and pass through the channels of the generator), and two copper Helmholtz coils (to create the initial magnetic field perpendicular to the stream). And then the current flows. The current passes through the coils, reinforces the field and initiates the self-excitement of the generator. Then as the current strengthens, it passes through the inductive storage (which is in the form of an aluminum solenoid coil), and at the peak of the current the circuit is opened and the current jumps to the flash lamps.

We needed a current of around 200,000 amps, a generator of around 500-600 megawatts, and a storage unit of 300 megajoules. Nothing of this sort existed in the world, and when we turned to our professors they declared, as usual, that these items were impossible to create. We did locate a rocket – the first stage of the rocket “Pioneer,” the famous SS-20<sup>159</sup>. The only thing is that we had to burn the

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<sup>159</sup> Later this rocket was developed into and used as a medium-range ballistic missile with a nuclear warhead.

cesium additive gunpowder much faster than normal – at around the rate of one ton of gas per second. So we had to create a whole different set of nozzles. The overall working time for the generator was very short, around 10 seconds, so the walls did not have an opportunity to overheat, and neither did the coils. Therefore it was possible to build a lightweight, mobile apparatus.

After the discussion, we went to report to the Secretary of the Party Central Committee, Dmitri F. Ustinov. We gathered in the Old Square at the first entrance. We were met by the head of the Defense Department Ivan D. Serbin (“Ivan the Angry”). He began by slapping the grand Millionschikov and asked "Come to fool us again?" Then, after putting all of us in our place, he lead us to the offices of D.F. Ustinov – a man of strict rules, but with a good sense of humor. He listened attentively, and ordered us to prepare a resolution for the Party Central Committee and the Council of the Ministers, as well as to prepare schedules for the Military-industrial committee chaired by L.V. Smirnov. After the end of a conversation I became insolent and went to Ustinov, and asked him to build a test site in Pakhra. D.F. was somewhat dumbfounded by such impudence, then smiled and said to the minister V.D. Kalmykov, "Come on, build it, we have no choice." Everything was built, and very quickly...

In the MIC I got involved in the preparation of resolutions and decisions and went through an excellent school. Work was led by the Minister of Defense Industry S.A. Zverev (a big fan of the optical industry), rocket and gun powder work was assigned to Boris Petrovich Zhukov, the future academician and pioneer of our solid-fuel rocket

technology. A. A. Raspletin commissioned the development of the laser to Boris V. Bunkin – the creator of the famous air-defense system C300. As a primary plant we identified the plant “number 96” in the city of Gorky (Gorky Machine Building Plant), which during the war produced more anti-tank guns than the whole of England. I talked to E. Komar, director of the D.V. Efremov Research Institute of Electrophysical Apparatus, to take on the task of building the magnetic systems, storage devices and circuit breakers. Further work was led by his deputy and successor, Vasily Andreyevich Glukhiih. An excellent functional and friendly company was established for many decades.

My life was split between Pakhra, Gorky, Leningrad (Metallstroy, EFA Institute), the construction bureau “Almaz” (Bunkin), Krasnoarmeysk (test site), the Kremlin (Military-industrial committee) and the Old Square (Party Central Committee). At Pakhra the team developed the laser units and circuit breakers, and created the world's only practically operational MHD-generator with a capacity of 600 MW (almost like a nuclear power station) – the largest one-gigajoule inductive storage in the world, and the laser itself had a pulse energy of 1 megajoule. All was accomplished, and these accomplishments still hold a record. But our customer refused to take the weapons, as there appeared a hope to make everything cheaper and more compact by using new efficient lasers operating on carbon dioxide. Boris Bunkin abruptly turned the steering wheel. It was the second sharp turn. I had no choice but to follow him, especially because the team at Pakhra was the

most qualified in the country in the area of low-temperature plasma.

Thus begins the third stage of our epic. However, it is difficult to spin while standing on one foot, so I started looking for other applications for our talents. One simple idea appeared in geophysics. The time of operation of the pulsed MHD-generator fortunately coincided with the time needed for a magnetic field to penetrate into the Earth's crust from the depth of a few kilometers, to hundreds of kilometers. We started research in this area, but this is another story.

The second project was related to nuclear fusion research. I continued to cooperate with the theoretical department of M.A. Leontovich. I became a close friend with Lev Andreevich Artsimovich. Lev invited me on a trip to the GDR. We stopped in Berlin, in a small typical German hotel, near the Brandenburg Gate. The Berlin Wall did not yet exist. From Berlin we went to Jena to meet Professor M. Steinbeck. After the war, M. Steinbeck, as a member of the National Socialist Party, was sent to a camp. There he was found by Lev, who saved him from near death. M. Steinbeck received a laboratory at Sukhumi where he was developing the centrifugal method of isotope separation. Then he returned to East Germany, and received an institute in Jena. Jena, a nice typical German town, is the birthplace of Zeiss plants. M. Steinbeck built a house, and what struck me was that his house was bigger than the Institute! After Jena, we visited Baron von Ardenne (the "People's Baron"), and in Dresden we met with Klaus Fuchs, a real "father" of nuclear deterrence. So the trip was

very interesting, but the main thing for me was to establish a friendly and trusting relationship with Lev Andreevich.

At this time, the fusion program in Russia, despite the obvious success of Tokamaks, found itself at a crossroads. In the U.S. an attempt to accelerate the thermonuclear program based on L. Spitzer's stellarators at Princeton had failed, and there was a general gloom. Immediately there appeared an academic theory of universal Bohm diffusion, and a search began for universal plasma instabilities. Pessimism arose about the ultimate goal and about the idea of a need to focus on "fundamental" research using simple traps, so-called multi-field traps. This, of course, was a very attractive approach for many smaller groups in countless American universities. The physical nature of Bohm diffusion is similar to the saturation of the Hall current, which I have already described. No universal law exists, and the best conclusion is the following: in Ohm's law the plasma conductivity in a strong magnetic transverse field as  $1/\nu - \text{Ohm} = 1/BB$ , where B is the magnetic field. If one B is moved to the left, you get: Bohm =  $1/B$ , that's all.

At the Institute, Lev Artsimovich experimentally proved the absence of Bohm diffusion in Tokamaks, including the new Tokamak T3, as well as the possibility of obtaining electronic temperatures reaching tens of millions of degrees. The West, by tradition, did not believe this. Lev made a brilliant move and invited a group of physicists from England, which had just mastered a new laser method for measuring electron temperature. They abundantly confirmed the measurements of the Kurchatov physicists. Lev again was right.

Together with B.B. Kadomtsev, they concluded that, based on the "Tokamak" system, a fusion reactor could be built (!). We had to up with the organizational conclusions. A commission was created to develop a work plan, and I was appointed as its chairman – they needed my experience with the government. The Commission endorsed Lev's conclusions and proposed a plan for nuclear fusion research, including the construction of the world's first large Tokamak T10. It was necessary to proceed with its implementation, and Lev asked me to lead this work. The director of the institute at that time was A. Aleksandrov, with whom they made all the arrangements.

I want to emphasize the style of work of these scientists. I was very young (33 years old), without a doctorate degree, but it did not stop them. In those same years, Lev appointed Roald Sagdeev as the director of the Institute for Space Studies, and Yuri Osipian as the director of the Institute of Solid State Physics in Chernogolovka. I was appointed not only as the head of fusion research in the U.S.S.R., but also as the deputy director of the Kurchatov Institute. Pakhra became a branch of the institute. Thus, my life became diversified: laser weapons, MHD-generators for Geophysics, and Nuclear Fusion.

The people in Pakhra were young and cheerful, confident in themselves and their future. Our social lives began with dance, thanks to the Khrushchev-style private apartments that all of us received. Temporarily unoccupied apartments were used as a club. We danced rock-n-roll and twist. There appeared tape recorders and bards: Bulat Okudzhava, Alexander Galich and Vladimir Vysotsky, Juli

Kim, Tatyana and Sergei Nikitin<sup>160</sup>. We organized a House of Scientists in a small cottage. One of the first visitors was Igor Golovin, the deputy of Kurchatov. He had just finished the first openly published book on I.V. Kurchatov. We made our way to the House of scientists in rubber boots through construction mud. In the first row sat young women with infants on their knees (in the 60's demographic problems did not exist). There was youth, and enthusiasm at work and at play.

There appeared new books: *Doctor Zhivago*, *The First Circle*, *Cancer Ward*<sup>161</sup>. Pakhra was far from the capital, and our branch was controlled by the Party Committee of the Institute, who had plenty of their own affairs in Moscow. Therefore, ideological control was weaker. We established links with “Taganka” and “Sovremennik”<sup>162</sup>. People were brave. I remember, they asked me to write a letter to the First Secretary of Lithuania inviting the singer Nihamy Livshitsayte. I did not expect a catch, but I wrote the letter. She came and gave a great concert; many Muscovites attended. It turned out that this was her farewell concert before leaving for Israel.

The Research Center grew in Pakhra: the first new branch was the Institute of Terrestrial Magnetism, then the Institute of High Pressure Physics, the Institute of Spectroscopy, a branch of the Lebedev Physics Institute, and construction began on the Institute for Nuclear Research (Moscow meson factory). We formed a Council of Directors, which started to coordinate the economic life

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<sup>160</sup> Well-known Russian bards and poets.

<sup>161</sup> The latter two books are by Alexander Solzhenitsyn.

<sup>162</sup> Liberal-minded theaters in Moscow.



in town. As the first chairman academician L.F. Vereshchagin joked, “We, the Greeks, are poor people, to make a living we steal from each other.” But in general, despite the competition, we lived more or less amicably.

I dropped out of graduate school; I had been busy with work up to my ears and did not have time for writing a dissertation. However, this hindered the research, and A. Aleksandrov ordered me to write a summary of my dissertation. I wrote it pretty quickly. I went to my reviewer Andrei Gaponov-Grekhov in Gorky. There they had a rule: you put a ten ruble bill between the pages and the one who found an error in the text took away the jackpot. To their disappointment, this was not my case, not because there were too few mistakes, but because it was a short content summary. But we already knew each other, and I got away with it. At night I went to the station. I knew Gorky, as I had worked at the “Factory-96”, and often for several days lived there. I decided to take a short cut and went straight to the station through the area cleared for new buildings. The moon was shining, and a smooth surface reflected it. The smell was not very good, but in Gorky that happens. I entered the tram. It smelled, so I went into the train. It smelled too, so I climbed to the second bank, and the smell seemingly ceased. I came home, and then realized I was wearing new suede shoes that I had brought from America, and I had walked through a sewage spill. I put the shoes on the balcony, where they aired until spring.

My wife in those years still went on expeditions. On the eve prior to my dissertation defense the cat climbed up

into my bed, and all night long I was delivering the kittens. In the morning I got up, started my Zaporozhets and went to my institute for the dissertation presentation. The tires of my Zaporozhets were tubeless, and on the road one started to lose air. There was a special remedy for such an occasion - to pump water directly into the tire. Because of the pumping, I ran slightly late for the presentation. But people had been in a good mood; they waited for me, and decided to spare me from future suffering and to award me a Doctor of Science degree straight away. Therefore I managed to avoid the usual lengthy routine – first PhD, then Doctoral degree<sup>163</sup>.

After the defense we went together with Andrei Gaponov-Grekhov to Mikhail Aleksandrovich (M.A.) Leontovich's home, buying two "half-liters" on the road<sup>164</sup>. The very formidable housekeeper cooked some potatoes, served a herring, and we fully celebrated the occasion. I stayed overnight at M.A.'s home. At bedtime, he gave me a book to read, which was "samizdat"<sup>165</sup> by Zhores Medvedev about the activities of Lysenko (Lysenko was still in favor with Khrushchev).

In summer we took the usual route driving Zaporozhets to Crimea on the Tsar's beach, with a stop at Yalta and Foros. The following summer we went to Solovki. We were wandering through the swamps collecting cloudberry. In the shallow water of the White Sea small flounder were swimming directly under our feet. In Solovki we rented boats and rowed through the canals to

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<sup>163</sup> The Soviet Union's Candidate of Science degree.

<sup>164</sup> In Russia "half-liter" is a common short name for a 0.5 liter bottle of vodka.

<sup>165</sup> Samizdat was a key form of dissident activity across the Soviet bloc in which individuals reproduced censored publications by hand and passed the documents from reader to reader.

the Holy Lake. We stopped at the island and began fishing. Diving at Solovki is very unusual. There is no night in summer; the sun wanders along the horizon line. One can hunt under the water all night long. We mainly fished for perch. Perch inhabit the Holy Lake at three levels: small and medium-sized perch live on the upper and middle levels, where the medium-sized fish eat small ones, the giant perch can be found on the bottom level, with the medium-sized perch in their stomachs. Sometimes a harpoon from the pneumatic gun recoiled from their scales. The surroundings seemed unreal: you swim at night in the canal, the figures around look like white ghosts, while a famous church hovers over the lake, nicknamed Solovetsky Calvary, where the sadistic Solovetsky regime tortured prisoners and threw them down the stairs.

In the White Sea the fauna is rich underwater; there are many sea stars and anemones. In the dam there was an opening where we hunted for lancet fish. From the top you see the fish, and you dive for it. The lancet fish is inoffensive, but with powerful teeth, which can easily bite through a mussel's shell. If you inadvertently put a foot in its mouth, it can cling, which happened to one of us.

During that time the reconstruction of the monastery had not yet begun. All the monastery buildings were destroyed and trashed first by the prison camp, and then by the sailors. Authorities turned the monastery paradise into a Soviet hell, with torture chambers and the infamous "herring room" in which people were stuffed like herring in a tin can and left to suffocate. SLON, Solovki Special Purpose Camp was a test ground on which the Gulag

system of physical and spiritual destruction was first proven.

During one of the vacations, when Natalia again went on an expedition, I visited G.I. Budker in Novosibirsk at the conference on plasma physics and fusion research. At the conference I had many conversations with the director of the Princeton laboratory A. Gottlieb. At this time, Princeton was searching for a way out of the stellarator impasse and began to look towards the Tokamak. After the conference, G.I. Budker took the guests on the Angara River to a resort built by Khrushchev for Eisenhower in anticipation of his visit (aborted by the flight of F.G. Powers), then to Lake Baikal.

I stayed at Lake Baikal and took a steamer to Nizhneangarsk - a small town on the shore of the lake. I observed a famous mountain fault formed by a devastating earthquake in the early twentieth century, and then took a fishing boat to the river connecting Baikal with beautiful Frolikha Lake, surrounded by snow-covered cliffs. My American diving suit allowed me to fish taimen in the river and in the lake. Deep in the lake I was surrounded by an endless school of small fish. The school arranged an empty space around me and rotated at a certain distance - apparently this way they protected themselves from the seals. I had a spear on a long fishing line, but it did not bring much damage to the school. I hunted a huge pike for a while, and once almost caught up - it swam out of the mud by my side, like a submarine, but was heading in the opposite direction. While I was turning for the shot, the

pike quickly disappeared. Yet finally I tracked it down and killed it, but as it turned out, in vain - it was old and tasted bad.

From Frolikha I walked down to Lake Baikal on foot and reached the hot springs. From the road I watched the seals hunting. They swam like dragnets, driving the fish to the shore. Then they pounced on the fish, their formation crumbled, and they ate a bloody soup. I returned to Nizhneangarsk by boat, and from there by air via Irkutsk to Moscow.

Sometime later, friends invited Natalia and me to a student summer construction crew on the island of Sakhalin. There, we were immediately hooked up with a job: cleaning the skin of the recently-killed bear. We spent some time in Sakhalinsk, and then we went on to Kunashir island through Shikotan. On Kunashir we went north to the volcano. I learned to catch crabs. It is difficult to take the crab by hand. One time I was diving, seizing a crab with a string bag, and a wave threw us onto the rocks. The diving suit was helpful once again. A cold horizontal rain sometimes came from the Okhotsk Sea, sometimes from the ocean. Maybe it was not the rain but the seawater carried by the wind. On the beach near a small spring of hot water I dug a bath, and by adjusting the flow of hot and cold water using a dam built of sea rocks, I could create a local comfort zone.

We gathered for a hike deep into the Kunashir. First we waded through a thick wet bamboo forest about two meters high. Then we went to the fumaroles - small sulfur

volcanoes. If you plug it with a finger, the pressure starts to rise, and it spits out the sulfur. When we became quite cold, we went to a small mountain stream. The water was warm, so we got into the stream with our clothes on. While we walked upstream against the current, the temperature rose. We walked as long as we could tolerate the heat. We did not want to get out of the warm water. Around us were moss-covered trees and a cold slanting rain, but we were warm and cozy.

On the shore, at the border control post, the guards were surprised how the very thought might come to our mind to go on vacation to Kunashir! We made a deal with the driver of a Studebaker, and he drove us to the other side of the island. We rode through the shallow seawater and through the devilish terrain with no trace of any road. It was a nice car. On the shore of a little bay on the Sea of Japan we set a tent. From there, in good weather, we could see the island of Hokkaido. I immediately got into the water and came upon a huge halibut – half a meter by half a meter. I pulled it out, and we realized that we didn't need to fish anymore. Later, passing fishermen gave us some pink salmon; we also ate crabs and scallops. I was diving with a camera, finding fish, taking a picture and flicking the fish on the head just for fun.

We returned to Sakhalin. We dove in the lake, and I met one brave fish, desperately defending its spawn. Then we moved to the ocean shore and set a tent. At night a storm began. I had an impression that someone was pouring buckets of water into our tent. We got out, folded the tent, put on our overalls and walked to town. On the road we went into a public bathhouse and dried ourselves. At the

airport we set our backpacks in a baggage storage room (in our backpacks was some pretty stinky seafood) and waited for our flight. Before the flight we were given our backpacks back with an expression of hatred. It was one of our usual problems. Our second problem was our lead diving belts, weighing about 20 kg each. Usually I carried them in a small carry-on bag to avoid paying for the extra weight.

From Pakhra we drove our Zaporozhets to Plescheevo Lake for the first time. We drove straight to the shore. The good thing about a Zaporozhets is that you could pull it out of mud just by hand. We set a tent, caught some roach and pike fish, and fed the mosquitoes. At night we sleep very soundly and did not notice that someone stole our rubber boat. So that was our first acquaintance with Pleshcheevo Lake.

Shatura became a more consistent place for our hunting and mushroom gathering. The news came that at Shatura station, the first power plant outside Moscow that was built under the GOELRO electrification plan<sup>166</sup> by Academician A.V. Vinter, the peat was running out. At this time I began to look for ways to expand our work on controlled thermonuclear fusion. I decided to follow the example of Academician A.E. Sheindlin, and to interest the Ministry of Energy and Minister P.S. Neporozhny in our work on Tokamaks. I was supported by A.P. Aleksandrov,

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<sup>166</sup> GOELRO is the transliteration of the Russian abbreviation for "State Commission for Electrification of Russia". The GOELRO plan was the first-ever Soviet plan for national economic recovery and development, initiated and supervised by Vladimir Lenin. The Shatura power plant was built in 1925, and initially used peat as its fuel source.

who had a good relationship with Neporozhny. I went to the Shatura station and got to know a wonderful engineer, Sergei Maximov. During the war he was a pilot and was injured, so his spine was damaged. Despite the disability, he graduated from the Moscow Power Engineering Institute, and began a successful career in the energy business. At the time he was director of the station, and was like the father and owner of the city. He was a remarkable man, a talented engineer, energetic, inquisitive, adventurous and friendly; we were friends until the end of his life.

Since the power plant was converted to natural gas, the decision was made to put one of the Tokamaks in the vacant building, where it worked successfully until the 1980s. In connection with widespread plans for cooperation, Aleksandrov invited the Secretary of the Moscow Regional Party V.I. Konotop to visit Shatura. I remember a trip in two Chaikas<sup>167</sup> to the cooling lake that was stocked with crucian carp. Crucian carp in sour cream fried in a huge pan was a great delicacy in Shatura. Nowhere in the world have I eaten a more delicious fish dish. We easily agreed on every detail of our project, and my connection with Konotop played a big role in the future in my life. On the way back, according to tradition, on the border of the district we drank a generous drink “for the road”, and all the way back Aleksandrov and Konotop sang Ukrainian songs (it turned out they were originally from somewhere in neighboring Ukrainian villages)

With Sergei, whom my wife and my son liked very much, we established family ties of friendship. We often

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<sup>167</sup> A Chaika is a luxury automobile from the Soviet Union made by GAZ.



went together to hunt and gather mushrooms. Sergei had close friends in all the neighboring villages. Once we stopped at the woman nicknamed "mother". The hut was completely packed with people. We slept side by side on the floor. The "mother" fired a Russian stove, put straw on trays and prepared for all the guests an incredible amount of dried white mushrooms. We stayed at her place again in the spring during duck hunting season and in winter, when we hunted hare. We bathed in the Russian "black" bathhouse<sup>168</sup>. During game hunting Natalia became famous: instead of a woodcock she got a goose, a much more desired trophy.

It was time to organize our village life. We almost decided to settle in Shatura on the Holy Lake. But somehow we were invited to celebrate the New Year near Pleshchevo Lake. On December 31 the roads were terribly icy. At the Yaroslavl highway my car spun out of control and for a long time we were going backwards. Luckily I had experience driving on ice, and there was no oncoming traffic. We came to a village named Usolie. There, a two-story hotel with a restaurant was rented for us. Everything was organized by Anatoly Petrovich Miroshnikov, he was already a frequent visitor there. We gathered from two companies: one from the Kurchatov Institute, the second from Podolsk, our "allied" group. Slava Pakhomov from the Bochvar Institute, witty and acerbic, was the soul of the company. Wild boar with cranberries, loads of pies, kvass - everything was local, and a novelty. In the morning the

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<sup>168</sup> In a traditional Russian "black" bathhouse, the smoke escapes through a hole in the ceiling, while in "white" ones there are exhaust pipes to vent the smoke. In the former, the escaping smoke darkens the interior wood, hence the name.

village men came to sell meat and at the same time we offered to buy a house in the neighboring village of peat workers, named Talitsy, for 800 rubles. Nickolai Ponomarev (Deputy of Millionshtchikov) and I chipped in and bought it as a hunting lodge. We lived there for 35 years, so I never went to any holiday home, or any resort.

The Village Usolie is an old Russian village, the same age as Pereslavl Zaleski. The village's power of self-government was given by the tsar's decree in 1550. Salt was mined there back then<sup>169</sup>, and the village was used as a hideout during the Tatar invasions. From Pleshcheevo Lake flows the charming river Wexa, on which Usolie stands. Wexa is blocked by a dam, and a few kilometers later it flows into Lake Semeno, and from there follows the famous Nerl river that joins the Volga. In the 1920s, they began to mine peat for the Shatura power plant, so they brought in workers, built the peat mining town Kupanskoe on the opposite bank, destroyed the local church and destroyed Usolie as well. A predatory destruction of pine forests began. At this time M.M. Prishvin<sup>170</sup> first appeared in Usolie and wrote an article in Pravda. Following this article, the first government ruling on ecological preservation was decided. Prishvin came back during the war and remained until 1943, working as a surveyor on a narrow-gauge railway. The nature of Usolie is described in his remarkable stories. During the war years there was a labor camp there first for our prisoners, then for German POWs.

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<sup>169</sup> Usolie has a root, "salt", in Russian.

<sup>170</sup> Mikhail M. Prishvin (1873 - 1954) – Russian and Soviet writer, author of works about nature.

Gradually the villages improved. There appeared schools, a hospital, and a club. The peat company built a network of narrow-gauge railways, workshops, a boiler house, a hotel with a decent restaurant, as well as an asphalt road to Pereslavl. Of course, the barracks remained from the German concentration camps, and drunkenness flourished, but there was some hope for the future.

Then Perestroika came. The peat industry was completely destroyed. Soviet authorities got continuously drunk and were caught stealing. Local self-government was eliminated 500 years after the tsar's decree, and the government center was moved over 40 km to the suburb of Pereslavl to make it easier to steal from. Heating was converted to oil, and for many years the public bathhouse did not work, and still is not working. The network of narrow-gauge railways was dismantled; the rails were sold off for fences. The club still looks like it went through the battle of Stalingrad. Well, the church of Usolie is now restored and, in addition, there is a remarkable new wooden church in Talitsy. Here, a unique world famous private museum of steam locomotives was organized, and broadband Internet is now available.

A private commerce is developing, and now for the first time since the revolution, the supply of goods no longer is in question. In Soviet times, the store was mainly selling salt and matches, and yeast was sold only in combination with wet sugar<sup>171</sup>. The school is now in poor condition, unlike in previous years, when some graduates were able to independently go to MIPT, MSU and to Mechmat. Between the two villages only one cow remains.

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<sup>171</sup> Which makes it easier to brew moonshine.

Potato planting has ceased. There is no hay harvesting either. Summer cottages appeared, and Muscovites now provide employment. There is some private industry, but local authorities have no interest for its support or development. The poultry farms and meat farms are completely destroyed, as well as the wastewater treatment facilities. The city dumps into Lake Semino waste with questionable cleaning, and the river Nerl is dying. "Quo Vadis, Lord?"

Switching to gas lasers meant a complete revision of the concept of laser weapons. First of all, there is the question of an energy source. We tried a solution with a pulsing nuclear reactor, because one such reactor was available at the institute. I invited Sasha Rakhimov from the Laboratory of Plasma Physics, Moscow State University, to take part in this work. Direct laser excitation by fission fragments turned out to be unsound, partly due to the reason of radiation safety. But we found experimentally that in the case of additional ionization by fission products, a discharge laser begins to work with much better stability and efficiency. A simple explanation was suggested. For a conventional discharge, electrons play a dual role – they excite nitrogen molecules, which accumulate energy, transfer it to a molecule of carbon dioxide and maintain ionization. But the energies needed for ionization and excitation are different by an order of magnitude, and therefore for the stable and efficient operation of the laser it is better to separate these functions. We published a paper on this subject. After a couple of years, Americans patented

this idea. I tried to challenge the patent using my American friends, but only managed to receive recognition of the right of free use of this principle in our products. Not so bad when you consider that no sale has happened yet.

There are two other possibilities for separating these functions, by space and by energy. We have implemented both possibilities in fast-flow lasers with a wave of ionization at the inlet to the discharge excitation chamber, and in pulsed lasers with ionization by a high energy electron beam.

First of all, it was necessary to formulate a realistic concept for this approach. For the fast continuous flow-through lasers we found the limit on the gas pressure to be a few tenths of an atmosphere. A high-powered laser with a closed gas flow is too bulky and heavy, and this is why we chose an open circuit model. Two possibilities were considered: aircraft and naval ships. In the first case the laser operates only at a certain level, for the second you need a compressor. We teamed up with Minaviaprom and the Kazan Design Bureau<sup>172</sup> of Professor P.F. Zubets, who created the famous rocket engine RD-3M, and an excellent company to create a compact on-board gas turbine power plant. A jet aircraft IL-62 was chosen as a platform. I met with Henrich Novozhilov, and he sent us to the Design Bureau at Taganrog. For the design of the sea ship we identified Design Bureau Altair and a proving ground in Feodosia for testing. The power plant on the ship was developed by Philip Rutberg.

Thus, at Pakhra the Ministry of Defence, the Ministry of Radio Industry, Minoboronprom, and Minsredmash

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<sup>172</sup> In the Soviet Union, Design Bureau was a common name for research and manufacturing firms.

U.S.S.R. all met together. Relevant Design Bureaus set up their branches. All of this was run by weekly planning meetings under my chairmanship, a kind of an informal board of directors, and the necessary formal decisions were taken by the Military Industrial Commission. Leonid Smirnov was the chairman of the commission. The decisive factor was the continued support of Dmitri Ustinov, when he was the secretary of the Central Committee, a Politburo member and the Minister of Defense, all at the same time. As a result, at a minimum cost (10%) we surpassed the Americans: on the plane we had a 1 megawatt laser (the Americans had 300 kW), while on the ship we had a 5 megawatt laser (and they had nothing even close to that). Perestroika and the collapse of the Soviet Union, of course, brought all of these projects to an end.

In conclusion, I want to say that scientifically, technically and administratively, we were able to solve any challenge, but only if we used our minds, rather than recipes suggested by boys and girls from the Higher School of Economics and if we were not hampered by rampant bureaucracy<sup>173</sup>. It seems to me that this scheme is a good example of free enterprise in Soviet conditions. When in the early 90's I created a youth organization named Achievements by the Young to teach our students the spirit of free enterprise, it relied not only on global and American experience, but also on my own. More than five million of our schoolchildren have been educated by this organization.

As I wrote earlier, we created a series of mobile impulse MHD generators with a capacity from 10 to 600 megawatts and the necessary technological and industrial

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<sup>173</sup> A reference to the management style of the Russian government-controlled firms of the 2000s.

chain for their mass manufacturing. The Americans were not able to create anything like this since they used much more complicated and cumbersome liquid rocket engines as their plasma source. We teamed with the Institute of Physics of the Earth and the Ministry of Geology and began a series of experiments on probing the earth's crust to study its deep structure, and mineral prospecting on land and offshore, particularly on the Arctic shelf. Per the proposal of the Institute of Physics of the Earth, we started experiments on the regular measurement of conductivity changes in the upper crust in seismic zones at the sites in Garm (the Pamirs) and in Bishkek (Kyrgyzstan). Here it was shown that several months prior to a major earthquake the conductivity of the upper layer of crust 10-20 km deep is increasing significantly, apparently due to cracking and conductive fluid in the cracks.

Work on the electromagnetic method of searching for oil, gas and other minerals began in the Urals and the Caspian basin, reaching a level of normal exploratory fieldwork. The collapse of the Soviet Union interrupted the process, along with most of the geophysical operations in Russia. On the basis of the Russian school of electromagnetic exploration, organized by Academician A.N. Tikhonov, a very successful team under the leadership of Mikhail B. Zhdanov was assembled. In the Time of Troubles<sup>174</sup> the University of Utah in Salt Lake City invited him to head a department. Zhdanov not only successfully organized the work of the department, but also created a very successful new organizational form, the so-called "consortium", with the participation of most oil and gas

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<sup>174</sup> In the 1990s.

companies. As a result, the department became the world's leading center on methods of electromagnetic probing. Now, in a new environment and in view of the energy crisis, we are together trying to resume these activities in Russia. In 2008, we organized an international symposium in Salekhard, the former center of the north Gulag, and now a modern European city, which I visited again after 54 years.

After the works in the Pamirs were discontinued, the geophysicists got a lot of free time to think. Professor N.T. Tarasov found that a relatively small pulse of electromagnetic energy, as a trigger, could cause long-term microseismic activity with the release of energy a million times greater within a period of weeks. As a result tectonic stresses can be removed, and perhaps it will be possible to not just predict, but prevent earthquakes. Even my grandmother used to say that financial problems exacerbated the mind of the scientist.

For probing, both an electric current and a magnetic field can be used. In the first case, a current from the generator is passed through the ground at both ends of the cable directly into the Earth's crust to create a magnetic field. In the second case, an antenna in the form of a loop is used. Since in both cases we are talking about currents in the tens of thousands of amperes, an antenna with the length of tens of kilometers would be too heavy and expensive. I had an idea to use the sea as an antenna. I looked at the map and saw a very suitable Rybachiy peninsula, connected to the mainland by a narrow strip of rock. We put a gunpowder-powered generator in the middle of the strip, lowered two ends of the cable into the Barents



Sea and ran a 20,000 amperes current around the peninsula. At the end we managed to create a map of the conductivity of the cortex of the Kola Peninsula - more than a million square kilometers! There are few more suitable sites in the world, but so far no one has dared such an experiment. On a smaller scale, we repeated the Garm experiments at the San Andreas Fault in California. Today, earthquakes, and the search for minerals, (especially on the sea shelf and in Eastern Siberia) present even more urgent problems than before. Electromagnetic probing, thanks to new information technologies, is on the rise. So this "child", it seems, goes on an independent path. A Russian proverb says "Small children - small problems, bigger kids - bigger problems".

We developed gas lasers rapidly. In May we, along with P.F. Zubets, signed off on the technical specification, and in October we launched a 100 Kilowatt installation in Pakhra. In this installation we not only optimized the optics and the laser design itself, but together with the Moscow Higher Technical College demonstrated welding of a 1.6 m diameter gas pipe with a seam in a vertical position. Thus we began a program of industrial lasers. One day V.I. Konotop phoned me and said that he would soon arrive. I came to meet him at the gate, but instead of his Chaika I saw the black limo of the Politburo member A.P. Kirilenko, the second man in the party at the time. With his help, we launched a program to create industrial lasers and their accessories: metal optics, special compressors, machine tools and automation. In this case, Dmitri Ustinov categorically forbade mixing peaceful and defensive uses

of the lasers. I turned to Sergei Pavlovich Maximov, who helped me to find a perfect place at Shatura, on the opposite shore of the lake from the power plant. With Kirilenko and Konotop we started to create the Laser Technology Center in Shatura.

At this time one of my team members at Pakhra, Galym Abilsitov, a very energetic Komsomol activist and one of the organizers of the construction teams, became free of projects. He was tempted by the proposal of independent work and practically created this unique research and production center, which is today one of the best in Russia. His industrial lasers and laser medical complexes are in many factories in the country and abroad. We helped to create the laser industry in Bulgaria. Current Director Academician V.Y. Panchenko not only saved and developed the Center in the Time of Troubles, but also created new areas such as three-dimensional laser lithography, which allows making artificial elements of skeleton for patients that have accident-related traumas, lasers for heart surgeries, that are performed by Academician L.A. Bokeria, Bragg filters for fiber-optic lines and much more. Thus, I gave a good start to this "child" as well.

In the field of fusion research, I used my experience with the Military Industrial Commission. In 1975 the Commission made a decision on the construction of the world's first Tokamak of the new generation, the T-10. At Princeton a similar decision was made on the construction of a Princeton Large Tokamak (PLT). Together with Melvin Gottlieb, the director of the Princeton laboratory, we had a bet about who would get the first plasma. I beat

him by a week. In Princeton, he tried to present me with a quart bottle of gin, but I went shopping and found a one-gallon bottle of "Beefeater". We finished it in Moscow. And so, we saved the U.S. fusion program.

In 1975 we launched the T-10. It started with some adventure, as we managed to burn off the coils. The machine was supposed to work for 10 years, but worked for 35 and still continues to give significant physical results. It has already paid for itself several times (although it would be better to build a new one). In the early years the T-10 was a tourist attraction; it was visited by chancellors, kings (Belgium) and other VIPs.

In 1971, Amasa Bishop (from the U.S.A.) and I met in Vienna with IAEA Director General H. Eklund, and agreed to establish a Council on fusion research, reporting to the IAEA Director General. There was a problem with Europe. In Europe, the nuclear fusion research had already been merged under the auspices of Euratom. At this time no agreement was reached with Europe, so we did not recognize the Euratom, and this was reciprocal. But without Euratom there could be no effective international organization. Therefore I, as a representative of the Soviet Union, agreed to invite Euratom into the Council. In Moscow, I was attacked (by Sredmash and by the Central Committee), but I pleaded a poor knowledge of English, and gradually the situation was stabilized. Without this solution there would not have been an ITER project. Actually, this is the difference between a diplomat and a scientist: a scientist is configured to turn the impossible into the possible, and a diplomat, the contrary.

Dr. Bas Pease, a Director of the UK's Culham Laboratory, was elected as the first chairman of the Board of directors. It was a landmark decision. He successfully completed work on the laser temperature measurement in Tokamak T-3, as I already wrote. But in principle it is the British, with their experience of managing an empire in conjunction with their democratic traditions and a long history of supporting science, who are the best adapted to this kind of activity. Bas Pease put the Council to work, and we owe him the successful international cooperation that followed, which has undergone many political upheavals, the loss of an empire, a dozen presidents and general secretaries, and an uncountable number of prime ministers.

Launching the T-10 coincided well with the next Congress of the CPSU. With the support of A.P. Aleksandrov, who replaced M.V. Keldysh as president of the Academy, and of Y.B. Khariton, with whom we became closer because of my work on laser weapons, I wrote a letter to Leonid Brezhnev on the need for a long-term program on fusion research. The Defense Department of the Central Committee supported me. The item on the development of nuclear fusion research was included in the directive of the Party Congress, and in its wake came the decision of the Central Committee and of the U.S.S.R. Council of Ministers "On the development of research in controlled thermonuclear fusion". This trend thus received a solid foundation.

I was elected a corresponding member of the Academy of Sciences, and later a full member. On this occasion, in the village of Talitsy a funny conversation took

place. My neighbor in the village was a remarkable Russian man - Alexander Kuznechihin. During the war he lost his right arm, and his legs were broken. Returning home, he began farming: first grazing cows, and then with his wife Praskovya built his own farm. When, in connection with the expansion of my family, I began to build a house in Talitsy, he taught me carpentry. In complex cases, he took an ax and without guide ropes with one hand he would exactly whittle a six-meter beam. I started to cover the house with slate. When I covered half of the house, friends came and offered to celebrate this achievement. We began to celebrate at our place, and then went to Usolie. Natalia at the time had our little girl, diapers, and feeding, but still she let me go. The friends brought me back in an appropriate condition, and my wife said everything she was thinking about me. Of course, I was offended and went to sleep in the hayloft. In the morning I woke up and I could not understand anything. The light came somewhere from below. I took a step back and fell down the three-meter height. The back of my head very accurately struck the sharp edge of the timber (the scar remained for life), but God protects drunks. I touched my head - my whole hand was covered in blood. I found a bottle of vodka, washed the cut and went to sleep. In a few months N. Ponomarev came to the village and told Alexander that I got a promotion. He answered: "Well, what, you get on the hayloft, f...cking fall down from there, smile, and perchance you will get a promotion!"

In the last years of the Brezhnev stagnation the society had become very uneven. On the one hand, the reformers and liberal intellectuals became closer to the authorities. On

the other, deep in the party, the bureaucratic elite still dominated and everything "smelled" of Stalin. This is best illustrated by the story of the Laboratory of AT Rakhimov at MSU. It was in 1976, two decades after the famous student revolution, about which I wrote earlier. The Dean of the Faculty of Physics was Prof. V.S. Fursov, the Rector of Moscow State University was Academician R.V. Khokhlov, and the president of the Academy of Science was Academician A.P. Aleksandrov. I was Academician and a member of the Central Committee of the Komsomol. At one time, we had created together with V.D. Pismenny a Plasma Physics Laboratory at MSU with the support of the Academician I.G. Petrovskii.

In March 1976 one of the engineers from the Laboratory (Kandaurin) copied the "Gulag Archipelago"<sup>175</sup>. All the copying at this time had to be done in a special room under the control and supervision of the special security department on a bulky ERA copier. Note - this is 1976, the world's information revolution, the beginning of the era of personal computers! When Kandaurin started the copier, the KGB entered the room. They seemed to trace the spread of this book throughout Moscow. What instructions were received at MSU, and from which authorities, one can only guess, but the next day the higher party bodies started to scrutinize the laboratory. Moreover, the occasion was convenient - a young lab, with an inexperienced head (in November 1975, I had invited Vladimir Pismenny to Troitsk, to a branch of the Kurchatov

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<sup>175</sup> *The Gulag Archipelago*, a famous book by Aleksandr Solzhenitsyn based on the Soviet forced labor and concentration camp system, was strictly forbidden during Brezhnev's time. It was only available through *samizdat*, or self-publishers using manual typewriters or illegal copying.

Institute, and the laboratory since that time had been run by A.T. Rakhimov).

The Party Bureau of the Institute of Nuclear Physics, which oversaw the laboratory, behaved decently, trying to charge the minimum penalties. An official letter was compiled, close to the text of my speech given at a meeting of the party office of the institute. However, the Party Committee of the Physics Department at its meeting decided to expel A. Rakhimov from the party, ban a presentation of his doctoral thesis that was already prepared, and raised the question of reorganization of the laboratory with the involvement of its leadership of "experienced comrades" from the Physics Department. The meeting was conducted by the same unsinkable I.I. Olhovskiy, who 20 years previously had prevented my entry into graduate school, as I wrote earlier. Maybe today he stands in the ranks of the new Communist Party of the Russian Federation with a portrait of the leader? I immediately went to Rem Khokhlov, he called somebody up above, and we escaped with reprimands and delayed degrees, but the laboratory has survived and is successfully operating to this day.

"And endless battle! We only dream of peace  
Through blood and dust..." - Alexander Blok<sup>176</sup>

Thanks to the improving Soviet-American relations, a delegation from the U.S. Atomic Energy Commission headed by its chairman Glenn T. Seaborg appeared in

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<sup>176</sup> From his poem "On the Field of Kulicovo" (1908), translated by Evgeny Bonver.

Moscow. The fusion part was headed by Robert Hirsch, and we had discussed with him a possible collaboration. The next meeting was held in Washington before a visit by Leonid Brezhnev to Richard Nixon. It was officially organized by the State Department. Bob sat under a striped flag, we sat under the red. I suggested to drive around the laboratories and to make decisions on the spot. Bob did not answer yes or no. Then I called Ambassador Anatoly Dobrynin, he contacted Mr. Kissinger, and the wheels were set in motion. After the phone call, Bob returned as a new person, we quickly agreed, in principle, and our delegation went to the laboratories. As a result, we produced an agreement that was signed by Leonid Brezhnev and Richard Nixon, as well as the working plan. Our scientists went to the U.S. laboratories, and the Americans to ours.

Of course, with this unprecedented scale of cooperation a lot of problems arose on both sides, and for their timely resolution Bob and I conducted weekly one- to two-hour telephone conferences. Gradually, experience and confidence emerged. At this time, Bob brought the budget of the American program to \$500 million and began building major installations. We established a joint commission, which met twice a year: once in the U.S.S.R., the next in the United States. In a joint program to develop a hybrid version of the fusion reactor for producing plutonium, the American side was represented by John Holdren, who is now the director of President Obama's White House Office of Science and Technology Policy.

At the branch on the Red Pakhra, we began collaboration with Los Alamos National Laboratory on theta-pinch plasma compression by liquid liner, based on



pulse technology. For this work, I invited Alan Kolb from the Naval Research Laboratory in Washington. With him, we began the industrial implementation in the U.S. of pulsed magnetic welding for the nuclear industry and pulsed MHD-generators for geophysics.

In the early 70s in the U.S. there was the beginning of a boom for using lasers to carry out the compression ignition of thermonuclear targets (micro-bombs). Details of the process still remain secret because of their connection with the technology of nuclear weapons. In 1968, for the first time, in a secret report this idea was suggested by Andrei D. Sakharov, and then in open literature by N.G. Basov. In 1971, Teller said at a conference in Montreal that with the appropriate profiling of the laser pulse for the ignition, it would be sufficient to have only one kilojoule of light energy. Arriving from the conference, N.G. Basov, at a meeting of the Presidium of the Academy of Sciences said that Tokamaks were outdated and that he was ready to carry out a controlled thermonuclear reaction for 50 million dollars (in those days that meant 25 million rubles). Lev A. Artsimovich became very excited, for good reason, and asked me to create a commission to verify Teller's calculations. I invited B. Mikhailov from the weapons industry (future minister of atomic industry, then the leading expert in Sarov), S. Kurdyumov from the Institute of Applied Mathematics for mathematical modeling, and R. Sagdeev for calculating the interaction of laser radiation with matter. Our assessment gave not one kilojoule, but 10 MJ! Edward Teller was wrong by a factor of ten thousand. It was not his first mistake. Similarly, he made a mistake in calculations for the first thermonuclear bomb, although the

idea in both cases was interesting. Today, a common estimate is 10 megajoules, although the heirs of Edward Teller at the Lawrence Livermore Laboratory expect to get the same ignition using a few times less energy. By the way, their laser cost them more than \$5 billion. So we decided to seek other methods of pulsed fusion.

In the beginning, we considered the electron beam, and the Americans at Sandia Laboratory chose the beam of light ions. But the academician VP Smirnov suggested an ingenious method of compression of the thermonuclear target using X-ray radiation produced by the collapse of the metal liner (installation "Angara"). As a result, the nuclear fusion research program, adopted by the Central Committee and U.S.S.R. Council of Ministers, includes a T-15 Tokamak with superconducting coils, a pulse iodine laser for target compression (Sarov), the open trap in the Budker Institute in Novosibirsk, Tokamak TSP, and installation "Angara". After the success of "Angara" Americans jointly conducted with us various validation experiments, and launched a program of light metal ions at Sandia Laboratory. As a result, the program experienced major development. The plan was carried out almost before the collapse of the Soviet Union. Now we are trying to revive and complete the plan.

Over the years there have been substantial changes in our family. Natalia, after getting her Ph.D. degree, decided to focus on family growth. As a result, we've got a daughter Natasha and son Pavel. Traditionally, in addition to children, we had animals as family members. Dogs have

lived with us during our wanderings, but after we found permanent housing, permanent dogs appeared as well. The first was Maika. We were told she was a husky, and we waited a long time until she would mature and her ears would stand up. Finally, we realized that this was not happening, but we managed to fall in love with Maika anyway. She understood everything, she smiled and “sang”.

Roald Sagdeev moved from Novosibirsk to Moscow and gave us a purebred puppy, a Siberian husky named Enik. He had to be trained to hunt. We started with a squirrel. We had to look for a squirrel ourselves, so we chased them, hit a pine or fir with a long pole, and if a squirrel did not want to run out, we had to climb the tree. Following this "beast" we had to hunt a duck. With some difficulty we got to the lake; we had to swim through grass nicknamed "ball-cutters" to chase the ducks. Then there was a bear. A female bear named Masha lived near the town of Pushkin. She deeply despised dogs, and slept sweetly. Enik was also not encouraged by the sleeping bear. The coach told me "Come on, get there yourself, stir her up, but do not get close, or she'll cut your belly open". The bear looked like a big fluffy good-natured ball. She gazed with interest as I was jumping around, and suddenly in a flash a paw with huge claws zipped out of the "ball". Thank God I was wearing a thick Chinese sheepskin coat; she tore through it, but not through my gut. Enik received all necessary documents and was registered as a hunting husky.

The next stage was sex education for Enik. My wife and I went off somewhere, and Enik was left at Talitsy with our neighbor Nikolai Nikolaevich Ponomarev-Stepnoi. In

Usole, there lived a very old husky, and her master wanted to mate her with Enik. We made an agreement with N.N. for a “half-liter” and a pike. For Enik this was his first mating, and the bitch was very old. Therefore, the process took about two hours. All this time our son Vasya and his friends were sitting on a nearby fence, carefully watching and commenting. It was for them a good lesson in sex with a detailed demonstration.

Quite unexpectedly, we obtained another animal – a rhesus monkey. Natalia's friends learned that one woman happened to have a monkey. Both were absolutely not suitable to live together. The monkey was tied to a heating radiator, and destroyed all it could reach by hand or foot. The apartment was in complete chaos. We came just to take a look, but with an idea not to take a monkey in any case. However it was so miserable, nestled like a baby (actually, it was a baby then), that we could not resist. The monkey was a male, and his name was Yasha, or Yakov. All my friend Yakovs were Borisoviches, so we called the monkey Yakov Borisovich as well. Yakov Borisovich Zeldovich later told me "You brought shame to my name, but I still voted for you" (for election to the Academy of Sciences).

At first, Yakov found his place in our social hierarchy. For the time being he implicitly recognized me as a leader. Outwardly, he expressed it this way: in any case - guilty or wanting to achieve something - he sat down on my neck and began to rummage in my hair. He would “find” something there, eat it (he was not eating anything, he was just pretending) and smack his lips with feigned satisfaction. He tried to put other family members in their place. If he was blamed, he immediately rushed to the very

young and tried to transfer the general anger upon the young. Only if there was no one else to blame at all, he resorted to violent self-criticism: screaming, wringing his hands, or biting himself. He behaved exactly like Golem from the "Lord of the Rings."

His malignancy was as boundless as his destructive ingenuity. In Talitsy our hut was originally covered with shingles, and occasionally a hole the size of a child's fist appeared in it, and leaked when it rained. I would climb onto the roof and patch the hole with a piece of composite roofing material. Yakov would be sitting there, watching me closely and as soon as I got down, he would immediately remove the patch and work to expand the hole. Since he was a three-dimensional animal and could climb the wall up to the ceiling, during this run he always tried to mess up something: to throw down a cup of water or somebody's glasses from a shelf using his foot.

Once we were drinking tea in our friend's kitchen. Yakov was with us, as there was no one at home to stay with him. He sat quietly on the wardrobe and did not disturb anyone. On the wall the clock was quietly ticking. Every quarter of an hour a door opened, and the cuckoo leaned out to make sounds. It turns out that Yakov closely watched the process, finally figured the timing, waited, took aim, grabbed the cuckoo and pulled it out of the clock. Yakov's favorite activity at home or at rest was to bite off all the buttons on a coat, jacket or pants, if they were abandoned without attention. Once on the beach, he stole Natalia's glasses, climbed up a tree and from there with nasty joy bit off and threw down the pieces. It is impossible to enumerate all his dirty tricks. At the same time he always

tried to maximize the reaction of others, which he observed with great attention. At first we were afraid to let him go off the leash in the woods, but then he began to walk freely in the winter and summer.

The first time when we picked mushrooms, he climbed into my wife's basket and stole a morel. She took it back and gave him a cuff. He bit her. "Okay" thought Natalia "die if you wish." Yakov did not die and further demonstrated an excellent knowledge of mushrooms: he always bit off the correct piece of toadstool or amanita stem. He was hated by ravens, and he hated them as well. They swooped down on him in flocks, and he climbed the tree and shook it violently.

In summer in Talitsy, Yakov acted independently. Once he went after the guys to Usolie. This campaign of his for a long time remained in the memory and in the mythology of local residents. First he climbed onto the roof of the barracks, but nobody paid any attention, thinking he was a cat. This was not satisfactory for Yakov, and he went trekking through the barracks hallway, opening the doors. The townsfolk began to get nervous and chased him off with brooms. Then he climbed through the windows: first his head with protruding ears showed up in the window, then two hands with which he discarded everything standing on the sill, and, finally, he was there in the room. It was then that the residents realized that the devil had come to them, and they started to panic. Subsequently, they discovered his earthly origin and began dealing with him more vigorously.

Yakov loved to take down clothes drying outside and ran around the garden, waving them in the air. Once he

stole drying clothes from a local man on the beach. When the man wanted to get them back, Yakov abruptly bit his finger, so the local brought a policeman. We received a stern warning. In Talitsy, Yakov visited neighbors and harvested apples from their trees. At breakfast, he looked at our mouths to understand what we are eating. Sometimes he helped himself with his finger. When we attempted to protest, he would jump to the edge of the table, holding himself with hands and feet, and began furiously shaking the table. The dishes flew to the floor. If the table was folding, then, as a rule, the table would collapse.

Yakov was quite vindictive. One day a friend visited us, a rather plump fellow, about 120 kilograms, who was a colonel. When he passed by Yakov, he slapped him. Yakov remembered and, when in the late evening we engaged in wrestling with the colonel, Yakov waited for the right moment, came from behind and enthusiastically bit the colonel's ass, tightly covered with sweat pants. For the colonel, it was his main working tool, so for a couple of weeks he suffered at his job.

A special case was his hunting with Enik. Enik and Yakov were friends and hunted together for about a year. A fox or raccoon meeting a dog nose to nose and trying to bite will not allow them to get close to their withers. Yakov at this moment would approach from behind and pull the fox by the tail, the fox would drop his guard, and the husky in one movement would break its spine. Or, for example, they would hunt squirrels or cats, which normally scramble onto a tree, turn around and mockingly look down at the dog. Yakov immediately jumped up behind them, grabbed them by the tail and dropped them down to the dog.

I particularly remember the hunt for a neighbor's rooster. The bird was very combative and he constantly pecked his mistress. Once he got into our yard. Yakov sat on the roof and immediately issued a battle cry. Enik rushed for the rooster. The experienced rooster climbed into the woodpile logs, but Yakov jumped to the rooster and plucked its tail. Once we drove the hunters away and freed the rooster, he got out of the woodpile plucked and embarrassed, losing all his fighting spirit.

This camaraderie lasted until Yakov became interested in Enik's sexual devices. He crept up behind Enik and pulled on them. On this occasion the whole friendship ended and an era of deadly enmity began. Apparently, this was the sexual maturation of Yakov.

Once he gratuitously and unexpectedly rebelled against me. After that, as soon as Yakov would show up, I physically felt the air thicken with hatred. The question was: who would grab the throat first? Natalia ran around and shouted "You will strangle him, you will kill him!" The fact that he would bite me did not seem to matter to her. Yakov eventually managed to bite our daughter, little Natasha, out of jealousy. We had to get rid of Yakov. I tried to donate him to the Durov's animal circus. They said "No, thanks! It would be better if you gave us a bear." I knew Professor L. Krushinsky from the Moscow State University, who studied the intelligence of monkeys. I gave him Yakov with the condition that he not do experiments on him, but use him as a breeder. So he lived there happily ensconced in his harem. For a while we came to visit him, but then we were asked to no longer appear. Parting is always very sad. From then on in our family, there always



lived some creatures: several dogs and now, even a parrot, but that's another story.

Due to the growth of our family, the summer hut we shared became too small for us. In winter our friend, risking freezing his feet, brought two construction trailers. In that year, the authorities began to disassemble the old kids camps due to it being a fire hazard, so we managed to buy two sets of fragments: trusses, windows, doors, and old boards with nails. In those days, lumber and nails were scarce. But above all, it was necessary to put the trailers on brick pillars. We hauled brick ourselves from a brick factory near Pereslavl. We hired a "chemist", one of the so-called conditionally released prisoners, who worked at construction sites of chemistry factories. At the plant someone had to get into the dryer for the bricks, using a cable to catch a tray on which a brick pile stood drying, and try to get out alive. We had a competitor - a young lieutenant with several soldiers from a nearby military base. They felt no hurry to climb into the inferno. We, with N.N., poured a pair of buckets of cold water on our "chemist", dressed him in a thick felt coat, and he brilliantly executed the operation to grab the bricks. The next step was loading a truck. The "chemist" had access to a forklift with a bucket. He picked up a load of hot bricks and dumped them into the truck. Approximately a quarter of the bricks shattered. The truck's sides started to smoke, and we, in the smoke, rushed to Talitsy. There the bricks were dumped directly on the ground, and another quarter shattered. The next step was to lift the trailers and to build the pillars

beneath them using only the available pieces of brick. The “chemist” got a hydraulic jack, and I was mixing mortar in a specially adapted stainless steel tub from a morgue, which was given to me by my friend, a doctor. As soon as we gathered it all on the construction site, the "chemist" changed his mind and tripled the agreed price. Here N.N. showed his character and exceptional managerial skills.

"Take your jack and go back" he said to the “chemist”.

"Come on, drive me back" he replied.

"Why would we?" retorted N.N.

The prospect of carrying a 60-kilogram jack twenty kilometers back to the city was not appealing to the "chemist", so he halved the price. Finally, we set the trailers.

The trailers had a steel frame and consisted of two halves, connected by bolts. On a frame there were steel fasteners called “ears”. To these “ears” we screwed two standard beams 6.5 meters in length, and installed roof trusses on top of these beams. Installation of the first frontispiece trusses, weighing 200 kilograms, was a laborious deed. Further, it was necessary to install four-meter-high poles for the walls, and a thirteen-meter connecting beam on top. We set up the pillars and fixed them up temporarily with thin sloped supporting boards on both sides. Three of us climbed on the ladder and held this huge beam in our hands. At this very moment our fourth partner decided that the installation was complete, and went to knock out the supporting boards with his ax. How we managed to hold the beam at a four-meter height, God only knows.

Next, we started the finishing. First of all, it was necessary to insert window blocks that were seventy pounds each. I stood there, holding the weight of the block, and behind me came my youngest son Pavel (he was 1.5 years old) with a pair of pliers, and he pinches my ass. It turns out that he just got a hold of the new pliers, and was walking around, snapping, searching for a suitable application. Well, he found a good one. I was yelling and swearing, unable to let go of the block and so could not drive him away, and he, the scoundrel, kept pinching with the pliers "in an influx of happiness with his mouth half open" (by Sasha Cherny)<sup>177</sup>.

Then came the carpentry work, which our neighbor Alexander taught us. While each of us had built one house for ourselves, he, having only one arm, had built two. And at critical moments he always came to us with his ax and offered his help. During that time carpentry had a certain twist: it was necessary to remove the rusty bent nails from the boards to straighten each one of them (it seemed that for every time I hit a nail, I would hit my finger twice) and use them again in the same board.

We would carry our daughter Natasha and son Pavel with us into the woods for mushrooms and berries. My wife heroically nursed all three of our children, not only with her breast milk, but also with fresh wild strawberries, thus preventing any diathesis. Once she nearly lost little Natasha among young fir trees, while she was collecting butter mushrooms. At this time we had a housemaid, Elsa, a very

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<sup>177</sup> Sasha Cherny, real name Alexander Mikhailovich Glickberg, (1880 - 1932) was a Russian poet, satirist and children's writer.

strict character. Once Pavel said to Natasha "I have matches, let's burn the house." Natasha said "What would Elsa say?" to which Pavel replied "She will say nothing; she will burn with the house."

In the summer of 1977 Rem Khokhlov, Rector of the Moscow State University and vice-president of the Academy, invited me to the mountains. I was at that time very interested in the propagation of intense laser beams in the atmosphere, and he offered to organize a mountain test site. I could not go – I needed to finish building a home for the children. I was doing my carpentry work when a messenger from Anatoly Petrovich Aleksandrov arrived and told me the sad news. Rem Khokhlov had died in the mountains. I was urgently summoned to Moscow by S.P. Trapeznikov, the vice-head of the Department of Science and a personal friend of Leonid Brezhnev. Trapeznikov said that there was a decision to appoint me as the Vice President of the Academy of Sciences. That was my only meeting with him. He asked me to bring him a battery-powered razor from abroad. He gave me no other orders.

Aleksandrov was not particularly pleased with my appointment; he believed that I had enough responsibilities at the Institute. In addition, he had his own personnel policies, and he promoted his employees in a highly selective manner. But the deal was done, and to whom I owe the appointment I still do not know. I did not experience a frantic joy; indeed, I had too many interesting things on my back. Initially I was appointed as an acting Vice President, and six months later was elected Vice

President. I worked in this position for 20 years, while continuing my substantive work at the Institute.

By the end of his life Mstislav V. Keldysh<sup>178</sup> was tired and had become disappointed in many mega-projects. The question arose about his replacement. The first Vice President was V.A. Kotelnikov, the second on the roster was A.A. Logunov. Neither one had appealed to me as a future president or even vice president of the Academy of Sciences.

I must say that in those days the Academy was responsible for the development of science in the country. The science department of the Central Committee had predominantly ideological functions. A real driving force was the defense department and military-industrial Commission. The SCST (State Committee on Science and Technology) was present but did not become a real center. Therefore, the identity of the President of the Academy of Sciences and his relationship with the government played a key role in the development of "pure" and applied science. Fortunately, nobody was interested then in scholastic debates on fundamental and applied science.

After consulting with my colleagues at the Institute, I went to A.P. Kirilenko to persuade him to support Aleksandrov for President of the Academy of Sciences. The conversation was very keen and detailed. Kirilenko was interested in the scientific issues, in the attitude of the

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<sup>178</sup> Mstislav Vsevolodovich Keldysh (1911 - 1978) was a Soviet scientist in the field of mathematics and mechanics, academician of the U.S.S.R. Academy of Sciences (1946), and President of the U.S.S.R. Academy of Sciences (1961–1975).

academic community toward the science, and in international relations. He was at this time, as I mentioned, the second person in the party and was still quite sane. In fact, the leadership, Leonid Brezhnev, Dmitri Ustinov and Yuri Andropov, were well aware of the identity and activities of Aleksandrov, so I do not know whether my visit played some role in this matter. However, I came back in full confidence that the problem was solved positively.

Shortly before the general meeting Kotelnikov and Logunov visited me in Pakhra. They had no doubts about being elected to the posts of the President and Vice President of the Academy (respectively), so they wanted to get acquainted with the work on laser weapons, as they intended to develop a similar program in accelerator weapons at the Institute of High Energy Physics in Protvino (this idea, in my opinion, is pretty pointless, but more on that later). However, I already knew who would be the President.

Later I had numerous conflicts with Logunov. For example, he firmly stood in opposition to the work of G.I. Budker (in Novosibirsk) for a large-scale development of techniques of colliding beams, saying that it was only possible after the completion of the accelerator complex at Protvino. Since this complex is not completed now, and likely will never be completed, the consequences of this decision are obvious. In addition, unfortunately for Budker, aging M.A. Lavrentyev almost accused him of spying for France. I was sent to help Budker, I did everything I could, and then a heated debate in the Academy followed. But due to the political intrigues he never got a green light for his work.

The next conflict was linked to another attack on controlled thermonuclear fusion and Tokamaks. It all started with America, where occasional aggressive dabblers were pushing adventurous ideas like "cold fusion", "bubble fusion" or simply denying the obvious truth. This is a normal, albeit unattractive feature of democracy, which has legal ways of dealing with such quasi-science. In our country there are always opportunists who try to seize the moment. In this case, it turned out to be Logunov, who did not deign to even superficially understand the problem and immediately, based on some conjunctural considerations, supported all this crap. President Aleksandrov had to give Logunov a rebuttal at the general meeting of the Academy.

Now I had to work with Aleksandrov, as the Vice President in charge of the whole complex of physical and mathematical sciences and engineering. This complex was called "Section", and it included a number of branches of the Academy. Y.A. Ovchinnikov headed a similar chemical and biological Section, A.R. Vinogradov headed the Section of Earth Sciences, P.N. Fedoseev was the head of the Section of Social Sciences (he was like a commissioner of the party Central Committee in the Academy of Sciences). Chief Scientific Secretary was G.K. Skryabin. The science department of the Central Committee, as I mentioned earlier, was headed by S.P. Trapeznikov, and Zimyanin was the secretary of the Central Committee in charge of science. He, unlike SP Trapeznikov, was interested in science and its destiny.

A lot of everyday problems swooped down on me, but two of them I felt very keenly. Khrushchev failed to destroy the Academy, but inflicted on it some very serious

damage: key institutions of the technical branch were detached from the Academy and given to industries. No system had been established to replace the destroyed one. The Committee on Science and Technology did not take a proper place for several reasons. Actually, the country was facing the same dilemma as it faces today: to sell raw materials for pennies, or to develop a competitive industry?

An information revolution was unfolding throughout the world, and the productivity in the engineering industry was soaring. The Academy was left on the sidelines. Generally speaking, I was not well prepared for the position of Vice President, so I had to fight from the very start. It took me six years to organize the Department of Informatics with support of the President of the Academy of Sciences and the Party Central Committee (M.V. Zimyanin and D.F. Ustinov). The bureaucratic structures resisted: starting from N.A. Tikhonov and sectorial departments of Gosplan<sup>179</sup> to the academic administration. A mass introduction of personal computers into science, industry and education began, yet even progressive ministers like E.P. Slavsky and Minister for Education M.A. Prokofiev, while enjoying *personal* secretaries, chauffeurs and apartments, believed that *personal* computers would be too much! V.V. Grishin, Politburo member, secretary of the Moscow City Communist Party, and a graduate from locomotive college, said to me firmly that in Moscow, above all, he needed the proletariat, but not unmanned computer manufacturing.

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<sup>179</sup> Gosplan, or State Planning Committee, was the committee responsible for economic planning in the Soviet Union.



At the Academy of Sciences many were agreeing with progress in general, but they often opposed innovation for selfish interests, and some people still perceived cybernetics as the bourgeois and anti-Marxist science. The word "informatics" was perceived with difficulty, and many modern concepts simply did not exist in the Russian language. Yet even so a company of enthusiasts assembled, withstood the first fight and organized the Informatics branch of the Academy. Then there was a lot of wins and losses, until finally, following Boris Pasternak, I realized that "...you yourself must not distinguish your victory from your defeat."<sup>180</sup>

With regard to machinery manufacturing, first I met with the director of the Institute of Mechanical Industry, K.V. Frolov, and we, based on support from Aleksandrov and the Industrial Department of the Party Central Committee, began preparing the transfer of his institute to the Academy of Sciences. Simultaneously, N.P. Melnikov (who designed the Sevmash metal framework for my father) together with the deputy minister of Oil Industry, began campaigning for the development of oil and gas deposits on the sea shelf. Melnikov asked me to try to set up collaborations with the military-industrial complex, in particular with Sevmash, but Ustinov replied categorically that I should not even dare to think about it.

At the time, the ocean-going fleet began to flourish, including nuclear submarines. Still, I think that Ustinov made a strategic mistake not to use the military fleet for civilian purposes, like oil exploration. Diversification of the nuclear submarine engineering field would have created a

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<sup>180</sup> From the 1956 poem "It is not seemly to be famous..." Translated by Lydia Pasternak Slater.

healthier environment in the defense industry, and in the economy.

This issue was brought back to the table only in the early 90's. I managed to contribute to Melnikov's election to the Academy ranks, which was, in my opinion, a great asset to the Academy. The rapid modernization of engineering by automating production through the use of information technology in design and manufacturing was taking place throughout the world. With K.V. Frolov we began promoting these technologies, although the Soviet Union in general was considerably lagging behind the West.

But we had our original achievements, which, as usual, were not appreciated much. I met a remarkable engineer and scientist named Lev Nikolayevich Koshkin, an enthusiast, inventor and creator of the rotor-conveyor lines in the machine tool industry. Koshkin created a fully automated production of ammunition, which freed 400,000 people from this work during the time of war, for which, as was customary, he was nearly executed. Only the personal intervention of Ustinov saved him from arrest. In the seventies, he began to vigorously implement his developments in the economy and created a new branch of engineering. With great difficulty I managed to push him and his ideas to the Academy.

In the U.S.S.R., there was a belief that the foundation of our competitiveness should be low labor cost, so unmanned production was not needed. Today, we are still

working to disentangle the effects of these errors. Koshkin died in the early Time of Troubles, and his ideas vanished under the deindustrialization press. Now everything has to start from scratch. When we talk about brain drain, we should not forget how many brains and great ideas we have killed ourselves here at home.

In these times we, together with Melnikov, worked on the construction and launch of Atommash in Rostov. So along with computer science at the Academy, the program for recreating the Branch of Mechanical Engineering, as well as a program of scientific instrumentation, came into motion.

Hard work on the development of laser defense weapons for aircraft, ship and mobile platforms continued. These were all gas-discharge lasers of varying types.

For the plane we took advantage of low ambient air pressure and built a fast-flowthrough laser of a stationary type, in which the flow of working gas is mixed with carbon dioxide and ionized at the inlet to the discharge chamber, and then nitrogen is excited in a constant discharge. The nitrogen stores energy and transfers it to a molecule of carbon dioxide, creating population inversion. As a result, we managed to place a laser of 1 megawatt power on an IL-76 jet aircraft. Americans have reached only one-third of this power in their flying laboratory.

On a mobile platform we needed to use the gas at atmospheric pressure. Pulsed lasers with a gas ionization by the electron beam were created. With this laser we managed to shoot down a missile target at the Balhash test site.

Finally, for the ship the same steady-state system was used, but with the injection exhaust system, and we reached a level of 5 megawatts of continuous power. On the ground in Feodosia we tested a prototype and knocked down a fast flying missile target in the presence of Minister of Defense S.L. Sokolov. In this case, we competed with a powerful competitor A.G. Shipunov and won the competition. In this area, we won also over our U.S. competitors, as the costs (in comparable prices), according to our estimates, amounted to no more than 10% of the American budget for laser weapons.

I believe that we were able to establish an effective corporate body in a branch of the Kurchatov Institute, which included the Minsredmash, Ministry of Radio Industry, Minaviaprom, Ministry of Shipbuilding Industry and the Ministry of Defense. All matters were dealt with on the board of directors, which I was asked to supervise. Planning meetings usually were held once a week, but at critical times they were called every day. If necessary, the decisions were approved by the Military Industrial Commission and the Party Central Committee. It was very intensive work, with constant trips to test sites and factories. I had to live for two years at the Gorky machinery plant. In addition, it was necessary to communicate with the ministers, with the Military Industrial Commission (L.V. Smirnov) and the Party Central Committee (D.F. Ustinov).

I did not always have time to communicate decisions to my subordinates. Once E.P. Slavsky discovered that I had received a government resolution to build a big test and manufacturing building in Troitsk, and he had completely

missed that. Then, to cover up, he sent his deputy to level everything on the construction site, but I was warned in time, and I managed to install a few columns for the building. It would be a dangerous act to destroy freshly erected columns, so he had to report to the Minister. When I came to Slavsky to discuss the issue in his office, he looked at me furiously, took off his jacket, crumpled it and threw it into the corner. His emotions were very dramatic. Then he tried to take the building away from me, but nothing came of it. Ultimately, he very reluctantly provided me with funds, and I received payments at the end of the year by Deputy Finance Minister V.V. Dementsev from the funds that Sredmash did not have time to spend. The contractors took me at my word, and construction proceeded. Now, in the heyday of bureaucracy, all this does not sound very real, but this indeed happened, and the material evidence can be seen in Troitsk.

All this I tell to convince the reader that with the right approach even today we can do anything. All our troubles are found inside our heads.

In the seventies our cooperation with the U.S., Europe and Japan in the field of fusion was actively developing. Large and powerful equipment was created, bringing us closer to the cherished limit, the so-called "breakeven", i.e. the point where the power of the fusion reaction in a Tokamak would exceed the energy required for heating plasma to thermonuclear temperatures.

In 1975, we, together with the head of the U.S. fusion program E. Kintner, made a joint report at the meeting of the American Nuclear Society in Washington. In this report

we tried to assess where we stood and where to progress during the next two decades. The project moved forward more or less according to plan, but not immediately.

The session was conducted by Edward Teller, who warmly supported us. That support was so fervent, that it caused a furor among the other plenary speakers, because I "consumed" a lot of their time. After discussions with my friends David Rose, who headed the pioneering department of the development of fusion reactors at the Massachusetts Institute of Technology, and M.N. Rosenbluth, a patriarch of nuclear fusion research in the U.S., we concluded that we must prepare the next step, the development and construction of a prototype fusion reactor. By this time all the leading countries were attempting to implement the project on a national basis. In the U.S., there was even a law adopted, which unfortunately was quickly forgotten. And we in the Soviet Union began to design experimental thermonuclear reactors, and even had chosen the site for its construction at the Pine Forest near Leningrad.

There was an understanding that to achieve such an ambitious project it is necessary to combine efforts. Two things helped us. Firstly, we already had an agreement on the priority of Tokamaks. If this were not the case, we'd still be arguing about the merits of different systems, which has led to (as happened in other areas), several warring communities, pulling the blanket over themselves. Secondly, we had a mutual trust. First, we would all agree with each other, and only then with our superiors and colleagues. And finally, we created a tool for initiating international cooperation, the International Council, for reporting on fusion to the IAEA Director General. At that

time S. Eklund was Director General, and he strongly supported us.

In 1977, when the so-called "detente" was still going on, he asked all the council members to consider the next steps of cooperation. I offered to start a development project for the International Thermonuclear Reactor (INTOR). The Council was headed by a distinguished English scientist Bas Pease, director of Culham labs. He'd already had a successful experience of cooperation on the measurement of plasma temperature at the Kurchatov Tokamak T-3, as I already wrote. The British have a century of experience combining imperial globalism with democracy, and are usually very helpful in the difficult early stage of a major project. We also were very lucky to get help from G. Zelikman, advisor to S. Eklund. He was already retired, but still had a great influence and expertise at the Agency (in old Russia, this post was nicknamed "educated Jew assisting the Governor"). The start was very successful. The project was actively supported by Professor K. Husimi from Japan and by Academician B.B. Kadomtsev.

But it was rather difficult to synchronize the development of long-term projects and the current political situation. The Afghan war started, political relations with many countries worsened, but the project, oddly enough, has survived, bringing together an international research team. However, in this period, the project was only at the level of concept development. A similar project was discussed by our western colleagues at the Versailles summits, but without the Soviet Union. And only in 1985

did real joint work begin on the project to build facilities for an ITER fusion reactor.

My family life also changed. It was difficult to commute to work from Troitsk. In Zhukovka, an academic town on the Rublevo highway, a cottage of L.A. Artsimovich became vacant, and it was offered to us. Natalia decided to switch from geology to raising children. Our younger kids grew up here. When my daughter was asked "Where are you from?", she replied: "From the village of Zhukovka.

Some distinguished people lived in Zhukovka at that time: July B. Chariton, Yakov B. Zeldovich, Isaac K. Kikoin, Vladimir A. Kirilin, Mstislav V. Keldysh, Andrei D. Sakharov, Georgy N. Flerov, Nikolai A. Dollezhal, Deputy Minister of Sredmash Vladimir I. Alferov, and also Dmitry Shostakovich, the Rostropovich family, Alexander Solzhenitsyn, and Alexander E. Sheindlin started building a house. We were all very active in communicating at dance parties, in line at the grocery shop, in winter during ice skating or skiing, in summer during campaigns for mushrooms and berries, or just visiting over tea or vodka, depending on the temperament. Leonid Brezhnev, too, built a pair of cottages there. All of this pastoral life lasted for about twenty years and ended with the onset of the oligarchy.

Our friends rather surprisingly persuaded my wife to start a music education for our junior children. Natalia has



a good ear and understanding of music. As for me, during my young years I honestly tried to join the musical culture, stubbornly went to the Conservatory, listened to classical records, read books, but accomplished almost nothing substantial. I still remained at the level of songs of A. Vertinsky, A. Galich, B. Okudzhava, V. Vysotsky, Nikitins, and their followers.

My younger son showed a talent for music, so my wife took him and our daughter to an outstanding educator, musician Anna Danilovna Artobolevskaya. Anna put three year old Pavel at the piano and, in her usual friendly manner, began a fascinating story about the wonderful world of music. The story was accompanied by small little pieces, which characterized different animals, birds etc. After a fairy tale about a little bird, Anna asked Pavel "to feed beans to the bird", i.e. to show the corresponding notes on the keyboard. Pavel, without thinking twice, said that the birdie is not hungry and does not want the beans, then jumped from his chair and hid under the piano. As a result, it was our daughter Natasha who started to be engaged with music. She graduated from music school and later from Music College at the Moscow State Tchaikovsky Conservatory. It was a titanic task for her and her mother for fifteen years. Natasha became a professional musician, but then abruptly gave up music and joined the Moscow State Law Academy. After receiving her law degree she had beautiful twins, my granddaughters Veta and Katia, and devoted herself to their upbringing and education. Now Veta plays the piano perfectly, and Katia plays the guitar. The girls are good at dancing and singing. Pavel independently mastered the guitar, and later took private

lessons and now plays and sings wonderfully on our family holidays together with the girls, with Natasha, who regained her form, and with the son-in-law, who serves as a second guitarist, singer and entertainer. Thus, in the third-generation my family became musical, and who knows, maybe something worthwhile will come out of it.

My participation in defense projects led to yet another unexpected result. A.G. Basistov, a talented engineer and a practical scientist and a former student of A.A. Raspletin, was appointed as a supervisor of the anti-missile defense project. I'd been involved in this activity as the Vice President of the Academy of Sciences. Basistov got an idea to use an echelon of small rockets for space defense. Subsequently, this idea came to Edward Teller and was included into the draft of the Strategic Defense Initiative of Ronald Reagan. Basistov consulted with the famous rocket designer Chelomei, who immediately caught the idea, not very successfully combining it with his own idea of a mini-shuttle and contrasting this idea to the Buran, a large spacecraft, similar to the American Shuttles, developed after the death of S.P. Korolev by his successor Academician V.P. Glushko.

Chelomei went to Leonid Brezhnev with this problem. Brezhnev appointed a commission under the leadership of another one of Raspletin's students, V.M. Shabanov, who was at that time deputy minister of Defense for Weapons. To this Commission I was appointed from the Academy of Sciences. We quickly figured out that this idea was not feasible for technical reasons: this fleet of small rockets

would be unable to stop a massive attack of ballistic missiles. Chelomei was an energetic and ambitious man. He had lots of political power during Khrushchev's time (Khrushchev's son Sergei was working as Chelomei's deputy), and did not intend to lose this position under Leonid Brezhnev.

The final stage of the commission's work was approaching, and Chelomei invited me to his dacha, which was near Zhukovka. The table was furnished with foreign drinks, not very common in those days, the soundlights played, and in general the stage was solidly prepared. My "tuning" started. Chelomei offered me a deal: I would support his idea, and he would go to Brezhnev and would suggest to remove my "old man", Academician Aleksandrov, and to appoint me as the President of the Academy of Sciences. I replied to him that the choice of the president is one issue, but the system's inability to solve our problem is quite another, and these two issues are in no way connected with each other. Next came a long conversation with abundant drinking. We parted, crawling, but with nothing accomplished.

On the street the cars were waiting for us. My driver kept saying that I did not drink much, and Chelomei's driver kept saying that the doctors forbade him to drink. Then, to their ultimate surprise, we were taken out and placed in the cars. My driver drove me to my bathhouse, which was nearby. At home Sergei Kapitsa<sup>181</sup> was waiting for me, and wanted to talk to me. My older son went to the

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<sup>181</sup> Sergei P. Kapitsa (born 14 February 1928, Cambridge, England), son of Nobel laureate physicist Pyotr L. Kapitsa, is a Russian physicist. He is best known as host of the popular and long-running Russian television science show, "Evident, but Incredible".

bathroom, looked at me and went back to Kapitsa to say, "He cannot talk, come next time please."

By the morning I had slept it off and quickly came to my senses. Apparently, yesterday I had taken a long walk with my youngest son, the weather was cold, and so there was a lot of oxygen in my blood. I called Chelomei. I was told he was in intensive care in the Party hospital on Granovsky street. There he stayed for some time. The Commission's decision was negative, so our relationship with Chelomei completely drifted apart. Chelomei accused me of betraying the motherland, and then he used his connections to spoil my relationship with G.V. Romanov, an influential member of the Politburo from Leningrad. The authorities started to collect incriminating evidence against me, but a new era began, the era of Mikhail Gorbachev.

The implications of the Commission's work were twofold: on the one hand, an expensive, risky and dangerous project was prevented, on the other hand I was well prepared for the Strategic Defense Initiative of Ronald Reagan, and this allowed me to respond to it quickly and effectively. But more on that later.

At the Academy, I began to get involved in international activities. First it was on N.N. Inozemtsev's initiative, who appointed me to prepare proposals for the Party Central Committee in connection with the congresses and similar events. He headed the Soviet side of the Inter-Academy Commission on strategic issues with the U.S.A. National Academy of Sciences. Under the new U.S. administration of Ronald Reagan, it became virtually the

only bridge of communication on issues of arms control between the U.S.S.R. and the U.S.A. Pugwash conferences and other forms of international collaboration lost their former significance for various reasons, including the loss of active scientists such as Artsimovich, Millionshchikov, etc.

After the death of Inozemtsev I headed the commission on the Soviet side. From the U.S. it included such influential scholars as Marvin Goldberger (chairman), Paul Dotti, Wolfgang Panofsky of Stanford, Dick Garwin from IBM, who designed the first U.S. hydrogen bomb some time ago, and several other scientists from the military-industrial complex. We agreed on priorities and chose the most acute problems threatening the mutual security of our countries: the cessation of nuclear testing, the threat of anti-satellite weapons, the deployment of weapons in outer space, and the ending of production of weapons-grade nuclear materials.

At the same time, the Pope, concerned by the increased threat of nuclear conflict, addressed all heads of the most influential countries with a proposal to discuss our problems at the Pontifical Academy of Sciences. I was the delegate from the Soviet Union. Nino Zikiki, a well-known scholar and public figure in Italy, organized the E. Majoran Centre for Theoretical Physics in Sicily, near Trapani, in the small historic town of Erice. A seminar on nuclear war was assembled there. Prominent scholars such as Edward Teller, Paul Dirac, Pyotr Kapitza, Eugene Wigner, and many others were invited to this special seminar.

During this hectic time, I met Victor Weisskopf, the first director of CERN, Frank Press, a well-known

geophysicist, the President of the U.S. Academy of Sciences, the Assistant to the President for Science, as well as many other figures associated with the problems of nuclear arms control. I started active cooperation with the Federation of American Scientists, its president, Frank von Hippel and director Jeremy Stone. These contacts and joint activities, which lasted almost a lifetime, had a great influence on me.

Now it was necessary to create such an organization in the U.S.S.R., and I organized the Committee of Soviet Scientists for Peace, against the threat of nuclear war. All this work became a significant part of my life in those years. Its meaning was best expressed by Victor Weisskopf. In Amsterdam, at a meeting with the movement of doctors against nuclear threats, led by cardiologists E.I. Chazov and B. Lawn, he said that future human society, if it survives, will remember our generation as a criminal one, which organized the biggest catastrophe in human history, or as a wise one, which was able to prevent it.

Victor was the assistant of Hans Bethe, the head of the theoretical division at Los Alamos, involved in the creation and testing of the first atomic bomb. It was Victor who drove Enrico Fermi (who created the first nuclear reactor and carried out the first chain reaction in the history of mankind) and Admiral Leslie Groves (the director of the Manhattan Project) in his jeep to the epicenter of the first nuclear explosion at the test site in Nevada. They saw a glass plate with a diameter of three hundred meters. "Is that all?" asked Admiral Groves. "After this titanic work, the unimaginable cost of the apocalyptic explosion - is that all?" Victor answered "And what did you expect to see, a

hole to the center of the Earth?" But, according to Victor, the fate of Hiroshima and Nagasaki had already been decided in Groves's head at that moment. The Admiral came to the conclusion that the bomb must be tested there.

As a result of our joint efforts in the twentieth century, a nuclear catastrophe was avoided, although many times we were on the brink. I think of Victor Weisskopf as my main mentor. He was wise, persistent, and humble. I remember a reporter once asked him "Are you indeed the chief adviser to the Pope on matters of nuclear war?" Victor replied "The Pope consults with God, not with an Austrian Jew." I am grateful to all my teachers, mostly to the American ones, who showed me the true role of a responsible civil society in dealing with such a fateful issue for humanity.

The first meeting of the Academy of the Vatican was to be held in Rome in 1981. I received an invitation, but the Italians did not give me a visa since I was included on the "black list" of the State Department. My friends gathered at the Vatican, in a beautiful medieval palace of the Academy, discussed all the questions, and waited for me. When I finally received my visa and arrived at the Vatican, they celebrated my arrival, and then everybody departed. My wife and I were alone in Rome for 10 days!

Roman vacation! We walked all over Rome; it was a wonderful time. Natalia walked me almost to death. When we reached the fountain in the Piazza di Spagna, I dipped my feet into the water and came back to life. We lived near the Vatican. We did not enter the Vatican like tourists, so we were able to see much more. There was a restoration of

the Sistine Chapel, and we were allowed onto the scaffolding. And then the Roman Forum, Capitoline Hill, the Colosseum, the Caracalla Baths, countless churches, St. Peter's Basilica and Castel Sant'Angelo (familiar from memoirs of B. Cellini), villas and monasteries, the Rotunda... I cannot name it all. Since then, we have gone to Rome at least a dozen times, and all my impressions have superimposed on each other. The grandeur and beauty of the Eternal City is ineffable by words, but also is described many times by our great ancestors.

For a Soviet official on a business trip even an extra can of Coca-Cola was a problem, but still we managed to take a trip to Florence - a city-museum of Leonardo and Michelangelo, the Medici, and the conquistadores. When we left Rome, we asked about the Metro's closing time. We returned on time, but the Metro was already closed. We asked why and got an answer: "There were no passengers." We could not get used to this charming immediacy of Italians, despite the fact that we ourselves were living in a state that was not too well organized.

My next trip to Italy was connected with the centenary of the Academy of Sciences. I represented a totalitarian state, and I was treated accordingly. I remember arguing with the President of the British Royal Society. He said to me "Members of your Academy are not elected. They are appointed by the Party Central Committee."

"That's not entirely true," I said. "The elections to your Academy are not always fair."

"What nonsense you talk!" He was indignant.



"No nonsense," I replied. "When His Serene Highness Prince Menshikov<sup>182</sup> came to visit London and brought some medals and stars with diamonds, he gave one of them to Sir Isaac Newton. Newton elected Menshikov to membership in the Royal Society. We at the Academy have a letter with Newton's signature that Menshikov signed with three crosses, as he was illiterate." My interlocutor was embarrassed.

"For us," he said "this happens in not more than 30% of all cases."

"And we too do not have any more than that," I replied.

But the most important result of the meeting, attended by leaders of more than forty academies of sciences from around the world, was to draft and sign a joint declaration on nuclear weapons. It is completely relevant today, but when new people came to the leadership everything had to start all over again. First of all, the declaration states that nuclear devices are not weapons in the usual sense of military might. They are the means of mass murder, are required only to prevent their use by the enemy. Protection from nuclear weapons is technically impossible, but an attempt to create a defense only accelerates the arms race. The weaponization of outer space is equally dangerous. Continued development of new types of nuclear weapons and their testing should be stopped, as well as their distribution. There must be a commitment on non-use of nuclear weapons for offense, as well as a commitment on

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<sup>182</sup> Aleksandr Danilovich Menshikov (1673 – 1729) was a Russian statesman, whose official titles included Generalissimus, Prince of the Russian Empire and Duke Ingria. Menshikov was considered to be the closest friend and compatriot of Tsar Peter the Great.

prevention of their accidental use. It should be borne in mind that not everybody agreed with these basic principles at the time (and even today), and the agreement was not an easy one.

During these years there were discussions of the possibility of using nuclear weapons to compensate NATO for the Warsaw Pact's superiority in conventional weapons, the possibility of using so-called "clean", or neutron, nuclear weapons, as well as the concept of limited nuclear war that could be won. The discussions were hot, but the vote was unanimous. V. Weisskopf, Frank Press, the President of the U.S. National Academy of Sciences, Spurgeon Keeny and many of their supporters took an active part in the discussion. Edward Teller would never agree with the declaration. It was a good basis for further concerted action by the scientific community.

The next meeting in Italy occurred in Erice, Sicily, and in a totally different atmosphere. N. Zikiki gathered a very different audience in Erice: directors of weapons laboratories, the "hawks" like Teller and his friends, and the military leadership of NATO, although there were also opponents like Dick Garwin and classical physicists, who did not get involved in disputes over military and political issues.

A funny incident occurred in connection with the visit of the Canadian Prime Minister. He was late for dinner, as was N. Zikiki, and the crowd began to get nervous. The fact was that during the previous reception the Mediterranean lobsters, a Sicilian delicacy, were in short supply. Our great friend Anna Dadda was responsible for the food. She protected the lobster from premature looting. But a Nobel

laureate from Canada could not resist. He went to the table and said loudly "I am a Nobel Prize winner and I have the right to eat a lobster!" This happens with them. Anna tried to reason and to stop him, while numerous correspondents from the leading Italian newspapers immediately rushed to the scene. The next day newspapers all over Italy came out with scandalous material "In Sicily, the scientists gathered to discuss how to avoid a nuclear war. What use may they offer, if they themselves cannot avoid a war with a lady because of a lobster?" along with a photo of the attacking Nobel laureate and the heroically defending Anna. Anna instantly became famous throughout Italy.

Edward Teller was, of course, a talented scientist and a man with strong beliefs. It was Edward who brought Léo Szilard to Einstein to convince him to sign a historic letter to Franklin Roosevelt that opened the pathway towards the atomic bomb and the atomic age. He was also an active promoter of the hydrogen bomb and influenced Harry Truman's decision regarding the beginning of its development in the U.S. I think he, unfortunately, was right. It didn't matter if the Americans had begun to build a hydrogen bomb or not, Stalin would not stop. Scientifically and technically we in Russia were quite capable to do everything ourselves, which was proven in practice. But this struggle resulted in the trial of R. Oppenheimer, and ended with his prosecution, dismissal and harassment. Edward Teller was on the side of the prosecution. I would not like to discuss who is right or wrong. A study of this issue will occupy historians for another couple of centuries. But the scientific community ostracized Teller for that.

For a long time I did not realize the depth of the split. But once I "got involved." We had gathered to spend an evening with Frank Press in his apartment in the famous Watergate complex, which was said to be built half of concrete, half of the electronic eavesdropping devices. That is exactly where the famous scandal that led to the impeachment of Richard Nixon broke. Spurgeon Keeny asked where I was going to go next. When I said that I would go to California to meet with Edward, he asked "Why do you need this...?" I did not know the word and went to look in the dictionary. Frank's wife Betsy approached and asked what I was looking for. I answered. She burst out and sent her husband to explain. Then I realized how far the conflict had reached.

The history of the Manhattan Project is instructive. In our country a relationship between authorities and scientists is much easier and more confident. Perhaps this is due to the fact that the authorities have always had a choice: if they did not like the scientists, they could grind them into the labor camp dust, and recruit new ones. The government did not make a secret of this, though in practice it seemed to behave ethically. In America, on the contrary, Admiral L. Groves, immediately after his appointment as the head of the Manhattan Project, officially appealed to the Attorney General to arrest two suspected foreigners, Enrico Fermi and Léo Szilard, the only two people, not only in America but worldwide, who knew exactly what to do to build a bomb. If Szilard had not had any friends in Roosevelt's circle, God knows how world history would have turned.

Edward Teller belonged to a group of amazing Hungarians, who were a core group of developers of nuclear weapons in the U.S. Almost all of them were classmates, surviving in a foggy childhood during the communist uprising in Hungary, and fascism and communism after the war. Therefore, their negative attitude toward the Soviet Union was quite natural but not always rational. Their extremism created problems for them later in America. In Edward, this attitude whimsically combined with the unconditional support of scientific freedom and sometimes gave him the power to make moves that nobody else would dare.

Once, we, together with N. Zikiki, decided that the next meeting in Erice we would visit the Pope and discuss the situation. I arrived in Rome with my wife, and we stayed at the Grand Hotel. Suddenly in the middle of the night the phone rang. Zikiki yelled "Evgeny, a nightmare! You shot down a Korean passenger airplane!"<sup>183</sup> I was urgently trying to clarify the situation with the embassy. The reply was "We did not shoot the plane down, it flew toward the sea." I understood everything...

In the morning in the lobby I saw Edward. He was gloomy: on the plane his friend, a President of the John Birch society, was killed. I sympathized with him, saying "What to do... Even more reason for us to continue to work to improve the situation and to go see the Pope." He agreed and we went to the meeting. The Pope met us, and there was a very constructive discussion. I think that none of my

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<sup>183</sup> Korean Air Lines Flight 007 was a Korean Air Lines civilian airliner that was shot down by Soviet interceptors on 1 September 1983, over the Sea of Japan, near Moneron Island just west of Sakhalin island. All 269 passengers and crew aboard were killed, including Lawrence McDonald, a sitting member of the United States Congress.

more liberal friends would have agreed to go with me to see the Pope on that day.

The tragic story of the plane had unexpected consequences for Natalia and me. We wanted to have a good day wind surfing on the Plescheevo lake, and Anna, as a practical person, helped us buy the kit – the board, the mast, the sail and other tools, all with a big discount, since the sail had an advertisement for Italian beer. But who on a Russian lake in those days would care about this advertising? But it helped us to save precious money. One problematic question remained: how to load it all on the plane? But here, as they say, there would be a blessing in disguise. Italian airline workers refused to load our luggage in protest against the assault on the Korean aircraft. It had to be loaded by the passengers, including us. Everybody participated in this with pleasure.

At one of these meetings, we discussed the prospects for missile defense. Edward was very enthusiastic. In his high-theater style, he turned to me from the stage and, looking intently into my eyes from under his shaggy brows, and said solemnly with deep bass voice, "Eugene, I congratulate you with your wise government who placed missile defenses around Moscow!" I replied just as theatrically, "Thank you, Grizzly Bear!" For Edward had just had an exchange with a television reporter who asked why Edward needed a heavy cane (he never went without a cane, as his leg had been injured). He replied "What if suddenly in the mountains I would meet a grizzly bear?"

"But the stick is a little weak against a bear," laughed the reporter.

"And if the grizzly does not know that?"

This dialogue was held in 1982. The U.S. presidential election was approaching, and the Administration had to take a proactive stance towards Moscow, but apparently was not ready for talks. I felt that something extraordinary had been prepared in America.

At the next meeting with American scientists in Washington (CISAC<sup>184</sup>). I told them about my feelings. I said that there would be likely an announcement of something like missile defense with a space echelon. The scientists rejected this suggestion as an obviously stupid one, and I believed in their sincerity. But as I flew home, Ronald Reagan assembled the scientists and the specialists, and presented them with a surprise, his famous speech about Star Wars, the Strategic Defense Initiative. I was already prepared for this, first through the story with Chelomei (which I wrote above), and then through the meetings in Erice.

Upon returning, I immediately gathered the leading scientists of the Academy and had an individual interview with each one. The question was not so simple: how bad is the defense? If the Americans succeeded in this idea - good, it's still a defense. If they failed – also good, they would waste their money. Well, I did not care about their money, however I was most afraid that we would spend our money for nothing, since we had among the scientists, military and defense industry a lot of hunters for money and for related political influence. The question about the

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<sup>184</sup> CISAC - Committee on International Security and Arms Control.

wisdom and the ethics of defense arose many times before that, and after that. Fortunately, we had discussed this issue with the Pope and other top religious leaders prior to these events.

As a result, we signed and issued a declaration of the scientists of the Academy of Sciences. The reaction from the Americans was prompt. Jeremy Stone, the director of the Federation of American Scientists, immediately took the opportunity during a debate in Congress. In general, the scientific community criticized the Strategic Defense Initiative in a fairly united fashion. In the U.S.S.R., we teamed up with R.Z. Sagdeev and A.A. Kokoshin and began to prepare an "asymmetrical response." D.F. Ustinov received our proposal positively and created a commission under my chairmanship, with the participation of all interested agencies and individuals. The report of this commission was, in my opinion, quite reasonable and balanced. When Gorbachev came to power, we immediately acquainted him with our report, and I think it determined Gorbachev's initial stance in talks with Reagan. But, of course, neither the U.S.S.R.'s nor America's militant opportunists were cooled, so the U.S. administration continued to actively promote the SDI.

But back to Italy. Natalia and I regularly traveled to Erice during the next ten years. This city was visited by the Greeks, Romans, Carthaginians, Normans and, of course, Sicilians themselves - all have left their marks. They say it was here that Cyclops met Odysseus and told him, "I am your friend, I'll eat you last." The city has a restaurant,



Chiklope, and we usually had dinner here with the whole company. The town itself is situated at an altitude of 1000 meters above the Mediterranean Sea and the city of Trappani. The town seemed to be carved into the rock, and the cars on its streets are sometimes forced to drive with one wheel on the wall. We lived in the cells of the monastery. In the basement there was a rundown piano, which was played by all and sundry, and two barrels with excellent Marsala: one with a dry, another with Amaretto. Access to the barrels was free day and night.

The composition of the guests was fantastic: Pyotr Kapitsa and his wife, Paul Dirac and Lady Dirac (the sister of Eugene Wigner). They had been friends ever since their families worked with E. Rutherford. Dirac began his work with Kapitzza. One day, over a glass of Marsala, I asked Kapitsa jokingly what his most significant contribution to physics was. "In fact," he said "that I kicked Dirac out of my laboratory, and he became a theoretician." This, of course, was a joke from the same series as the tale of what happened to Dirac later. When, after an evening-long discussion with the fathers of quantum theory, the question arose of what should be the relativistic equation for an electron, they all went to bed, and Dirac hit upon the square root of the Schrodinger equation.

Fate presented to Natalia and me a unique opportunity to communicate with Lady Dirac. She appeared to us like the quintessence of great European culture, standing above the storms and nightmares of the twentieth century. Politically the early Reagan years were very tense, and I, as Vice President of the Soviet Academy of Sciences, was representing the camp of totalitarianism, while the other

fellows represented democracy. All of us, of course, above all, were united by science, but when the discussion would shift to strategic issues, we would find ourselves, naturally, on the opposite sides of the fault. Only the great European culture and its true representatives could unite us. This unity had been the goal of our hospitable host and his family.

I want to note a couple of acquaintances that grew into a lifelong friendship and, above all, the Dadda family, with Anna, about whom I wrote in connection with the lobsters, and her wonderful husband. We spent a lot of time with them in Venice (in their home on the Grand Canal), in Milan, and here in Russia.

A second acquaintance was with Father Elji, a Franciscan monk, who organized in Italy a number of colonies for the rehabilitation of addicts. With him we drove the whole family through the small towns of Italy: Verona, Padua, Bologna, Siena and the others, stopping at the Franciscan monasteries and colonies. We will always remember the inexhaustible kindness, cheerfulness and optimism of this little monk, barefoot or in sandals and in a cassock belted with a rope.

Another friend, Nino Zikiki, possessed incredible powers. Even before my first meeting with him, I asked an Italian friend "And who is Zikiki?" He said pointedly "Oh! Zikiki stands somewhere between the Pope and God." Soon, we were able to see this. Once we were stuck with Nino in Rome. We wanted to go to the ancient city of Ostia, but the mayor was not there on that day, and Nino could not go without proper notice. What should we do? I jokingly suggested that we should go ask for a reception

with the Pope. Nino disappeared, and after 40 minutes the Pope welcomed us.

Communion with Pope John Paul II was one of the strongest impressions in my life. He was a wise man and always felt the responsibility for the fate of people. At the same time he maintained an extraordinary simplicity and kindness in communicating. Once, our meeting ended rather late, and he suggested seeing the Vatican Museums. He called the Cardinal, who was also responsible for the election procedures. I remembered Gumilev:

And no one would look at the gatekeeper,  
Radiant Apostle Peter...  
He looks like a beggar, an uninvited guest,  
And the keys are hanging from his belt.

With these keys, we went through the empty Vatican. The Cardinal opened the cabinets, got out jewelry - solid gold crosses studded with diamonds, tiaras, a crown made of papier-mache, studded with jewels, used for the coronation of Pope Pius VII in exile. The tour was unforgettable.

Sicily - the cradle of European civilization. There are more Greek temples here than in Greece, and they are majestic - the Valley of the Temples in Agrigento, perfect Selinunte with its amphitheater open to the sea, Sedzhenta in the mountains. There are the workshops, where half-polished stones and tools are still lying around, as if the masters had gone on holiday yesterday. Wonderful mosaics of Roman villas. Palermo, with its magnificent temple, its Byzantine mosaic and small church with three red domes.

The Orthodox, Catholics and Muslims pray underneath each of them. Catania, with ever-smoking Etna, which Natalia has climbed (that climb nearly killed Professor E. E. Shpilrain). And lovely Taormina, with the Greek temple and the amphitheater facing Mt. Etna. There we were greeted by the mayor, a cardiologist by profession, who was in love with the city and eager to transmit this love to all guests. With each guest he drank a small cup of terribly strong and tasty coffee, which surely must have killed him prematurely.

Of course, we must remember that Sicily is not only the Mafia (the response of a patriarchal society to continuous invasions from the outside), but also Europe's first parliament in Palermo, and the birthplace of Archimedes:

Their choir coveted led the muses  
Away from evils and distresses,  
You love your native Syracuse,  
As it was loved by Archimedes (V. Brusov)

In general, Sicily - a singular epoch in our lives.

Apart from Italy, a center of attraction for Natalia and me was Austria, and in particular, Vienna. There, I formed friendships with Yura Chernilin who was working there as the Deputy Director General of the International Atomic Energy Agency, as well as good relations with all the Directors General of the IAEA, primarily through my connection with nuclear fusion and nuclear power

generation, which suddenly became my purview after Chernobyl. Natalia and I had a wonderful time in Vienna and its beautiful surroundings, including the famous restaurant on the Danube with carp *a la Serbian*, and its wine suburbs. In addition, as the Vice President of the Academy, I participated in a typical UN event entitled "Science for Development", where I was invited by Jermaine Gvishiani, the Chairman of the State Committee on Science and Technology and a husband of Kosygin's<sup>185</sup> daughter.

At the restaurant at our table was an African princess, a German married to the granddaughter of Karl Marx, the granddaughter herself, and one luxurious gentleman dressed in fox furs, resembling a character from the late paintings of Salvador Dali. He owned a chain of restaurants and casinos in the Caribbean and represented the poorest developing countries, while the German, married to the granddaughter of Karl Marx, represented the rich developed countries, which disturbed him deeply. The event ended with an incredible amount of paperwork, for which the whole forestation of a small country must have been wasted, and a lot of time to agree on the wording was wasted too. After the conference I never saw that paperwork again and have not heard anything about it. I think it safely sunk into oblivion. Personally, I defined the meaning of the conference as "An aid from the poor of the rich countries to the rich from the poor countries" and I promised myself to never participate again in UN events.

Natalia developed an absolute aversion to Jermaine. It resulted in a curious incident. Once I invited him and the

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<sup>185</sup> Alexei N. Kosygin (1904 – 1980) was Soviet Prime Minister.

Premiere's daughter to my dacha in Zhukovka. Natalia, I suspect, figured this out and knowing that I could easily forget about this, in the morning, without speaking, dragged me to the beach at Nikolina Gora with the children. Something similar happened again with A.N. Yakovlev, who at that time was a member of the Politburo. I invited him to my village of Talitsy. He, on his way from Yaroslavl, with some difficulty reached us in his government limo, but did not find anyone at home: an hour earlier Natalia took me to our friends in the nearby village where I got a bit drunk and had forgotten everything. Yakovlev recalled this incident for life.

Vienna, of course, has the Hofburg, and Bosch, and St. Stephen's Cathedral with organ concerts. Sometime later we met and, dare I say, made friends with a wonderful man, Cardinal F. Koenig.

Before all of these trips there was one that was especially significant for Natalia. Prior to my Vice Presidency she was not allowed abroad with me (and, especially, without me). But then the secretary of the Komsomol, Boris Pastukhov, invited us to the youth festival in Cuba. I was a member of the Komsomol Central Committee and the chairman of the Council of Young Scientists. We flew to Cuba. Already at the airport pleasant surprises began: real Cuban coffee in small cups, and plenty of tropical fruit. We were warned that in the morning we had to drink a glass of rum, which we faithfully did. We were placed in a former American hotel in the heart of Havana, which had remnants of bygone

luxury. A cold air conditioner blew inside, and a warm tropical rain ran down the windows. It was just like home, only the outdoor temperature was well over thirty degrees Celsius.

We were carried around to many stadiums, where we listened to the endless speeches of Fidel. Next to us were interesting characters: African bosses, Arafat, etc., and our delegation had high representation as well: Robert Rozhdestvensky, Mikael Tariverdiyev, Alexander Pakhmutova, Nikolai Dobronravov, and Marshal Lelyushenko<sup>186</sup>. On sunny days in the stadiums Cuban kids from the youth guard would faint, but the brave Marshal in full regalia cheerfully stood through the rituals. The ambulances were on duty for the youth guard. Once, Marshal said that all scientists should be put on their knees all the way from Moscow to Gorky. I did not understand the logic: Sakharov was still at large, and the city of Gorky had no ill fame yet. But I nursed my grudge, and at the dinner with Fidel and his brother Raúl, after Lelyushenko told a story of his visit to a tank brigade, I told my story about a general visiting a border post in Central Asia: Having tasted the borscht, the general asked the officers about the women. The Captain said, "They're so-so, but we have a female camel." The general commanded, "Come!" and going to the barn to the camel, the general asked, "How do you do it?" "With a ladder, Comrade General," replied the captain. After some time, the general returned in satisfaction and said: "Well, that wasn't bad..." Then the captain came to him and whispered in his ear, "Comrade

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<sup>186</sup> Soviet poets, musicians, and military.

General, we actually ride the camel to the neighboring village to meet the women.”

The feast was accompanied by a great show. In our spare time, we drove to the beaches, in particular to Varadero, which once belonged to one of the wealthy duPont families. At this time a comfortable holiday home for our cosmonauts was situated there. We were served by guys who looked like pirates. The spearfishing was also quite successful. At the end, we went to get acquainted with their shark, which lived in a large piece of pipe. It was, apparently, quite fed up with tourists. Therefore, when we tried to lure it out of the pipe, it did not yield to our provocations. So we started up a motor boat, tied the shark's tail and pulled. Apparently for the shark it was a familiar experience; it quickly freed itself and immediately disappeared.

The ocean was inhabited by fierce-looking barracudas, and while the locals were afraid of them, we swam in flippers and masks, and the packs made way before the divers. Once in Havana on the beach, we ran into a divine oasis with colorful tropical fish, ball fish, and other creatures. But after some time we understood the reason for this paradise: it was located around the sewer pipe from a nearby hotel. We dried our trophies in the hotel and people looked askance at us, but since we were VIPs, no one complained. The main part of the delegation came in by boat, and they lived on the boat, so we did not communicate much with them. From there, occasionally came all sorts of stories, for example, the story of a toothbrush. One passenger had forgotten his toothbrush in a common washroom. He came back and saw that someone



was brushing his teeth with it. "Look," said the passenger, "that's my toothbrush!" "I'm sorry," was the response. "I thought the brush was provided by the boat for everyone to use."

In Cuba we had all the fun that we could find. We went to traditional festivals with dancing, songs, performances, and lots of beer. In the evening we fearlessly entered the crowd and had fun until the morning. I can imagine how such an adventure would have ended up in America... so the trip was unforgettable! Unfortunately, there was no business outcome from this trip.

My collaboration with Japan also began from a formal interaction. As Vice President I was sent to the centennial celebration of the Japanese Academy of Sciences. The country already had connections through nuclear fusion and INTOR. From Japan the chairman of the Science Council of Japan, Professor Husimi, a real scholar and a wonderful person, participated in the project. Our friendship lasted until his death, and he lived to a hundred years. At the airport I was met by a science adviser of our embassy Nikolai Borisov, and we still work closely and our families are good friends. In Japan, the Academy of Sciences has mostly a symbolic role. Therefore, Nikolai took me to the most influential man in Japan, Doko-san, the creator of the Toshiba Company, and the Chairman of the Board of Industrialists in Japan. With him a real collaboration and friendship began. That collaboration has continued with his successor, and still lasts at the present time. Every time I come to the country, my longtime friend Yamamoto, at 8

am, gathers friends and supporters of the Global Infrastructure Foundation at the Prince Hotel, which is located in central Tokyo. There come the heads of companies, the members of parliament, and the ministers, and we openly and actively discuss the situation and our plans.

Doko-san was one of the founders of modern Japan and one of its most revered sages. He always tried to cooperate with the U.S.S.R.: he organized production of air conditioners in Baku, he supported cooperation in the energy industry, the exploration of the Sakhalin shelf, and nuclear fusion. Doko-san was a remarkable man. It was said that during the corruption trial of the Premier K. Tanaka reporters came to the village where Doko-san lived, and began looking for his residence. In the end, they knocked on the door of a small house, and a white-haired old lady in a home dressing-gown opened. She was asked, "Where is the mansion of Doko-san?" She replied, "I do not know of any mansion." "Who are you?" they asked. "I'm his wife." "And where is Doko-san?" To which she answered, "He left early in the morning on the train to work." These were men during those times...

The celebration was wonderful. While the men were greeted by the Emperor Hirohito in his palace, a special tea ceremony was arranged for the wives. Then all the guests gathered in a large hall. Local academics were seated in an amphitheater and at the gallery, and we were in the stalls. But, as I recall, there was no translation. The Emperor, the Prime Minister Okuda, the university rector and the President of the Academy appeared on the stage. They sat on chairs with high backs. The Emperor stood up, took out

a scroll and read it in a thin piercing voice. Then he sat down. The Prime Minister stood up and gave his speech in the same tone, then the others. The speakers, as it looked to me, after their speeches immediately closed their eyes and fell asleep. At night there was a reception on the top floor of the Hotel Imperial. At our table sat a daughter of the President of the Academy, the President of the British Royal Society, Lord Todd, Natalia, me, and someone else who I cannot remember. The President of the Academy of Sciences arrived, came to the microphone, hugged it and began to mumble something into it, dancing around. His daughter started crying and explained that her father, on the road to the U.S. embassy, had been drinking. The situation was saved by Lord Todd. He stood up, walked to the microphone and embraced the President (who was up to his waistline) and told a Scottish story:

An elderly lady had a runny nose. She went to a pharmacist for medicine. The pharmacist gave her some white powder. Coming home, the woman took a glass of water and prepared to consume the powder. At this point, someone knocked at the door. The apothecary stood at the door. "What's the matter?" asks the lady

"Did you already take the medicine?" he asks.

"Not yet."

"Then return it, please."

"Why?"

"I mistakenly gave you strychnine instead of quinine".

"A big difference?"

"No, only 5 pence." People laughed, and the atmosphere became relaxed. The evening ended

beautifully. I've always believed that the British learned a lot from the Empire.

We stayed at the conference hotel, with everything included. We invited Borisov to the restaurants, saunas and massages. I have to confess, we had a luxurious life. Then we traveled through Japan all the way to Kyoto. We visited many temples. In the temples people rang the bell and threw coins down into a box. A member of our foreign department rang the bell, but did not put in any money. I told him, "What are you doing? God has paid attention to you, and you've not thrown in a coin. He will reprimand you for that!" So the colleague looked at me in horror and immediately threw a few coins.

This way, my acquaintance with Japan began more than thirty years ago, with its ancient and modern culture and with its wonderful people, who always smile and bow, regardless of what they currently think of you. One can quickly fall in love with Japan, but it takes a lifetime to understand it. With Borisov and Japan, we are never going to break up.

I will go back to the days of "late Brezhnev" and "early Andropov." We were at this time pushing for a treaty banning anti-satellite weapons and the withdrawal of all weapons from space. Both we and the Americans were interested in this treaty, but in Russia and in the U.S.A. there existed groups who resisted. A.A. Gromyko drafted an international treaty, and we were about to send it to the UN. I offered to discuss the draft with the American scientists. Marshal S.F. Akhromeyev supported this idea,

and we received comments from the U.S.A., mostly from Dick Garwin. Then something unprecedented happened; the comments were taken into account in the drafting. Unfortunately, the Reagan administration was set up in a negative mode, and the SDI appeared.

So the treaty did not work out, but something more substantial happened as a result. Akhromeyev persuaded Andropov to sign a unilateral moratorium on testing of anti-satellite weapons and on the weaponization of space, and the U.S.S.R. adopted such a moratorium in August of 1983. In response, the Democratic Congress then cut off the funding for similar work in the U.S. Things reached the point where the Americans launched a satellite target into space and did not have money to run an experiment on its destruction. This moratorium is observed today. A couple of times, the Americans have tried to break it, but nothing significant has been accomplished. As my great-grandfather Evreinov used to say, "We did not create Venus de Milo, but at least we got something venereal." However, the treaty still does not technically exist, which is an injustice, generally speaking.

The main concern of mine at the time was the mass introduction of computers. In the Soviet Union a powerful industry of information already existed, but it was mostly aimed at the needs of defense. Any commercial application was considered secondary (even the term "commercial" had a criminal flavor then, and was not used). Thus, the industry completely relied on the state budget, was highly centralized and monopolized. Microprocessor revolution and personal computers did not fit into this scheme. Gosplan, the State Planning Commission, was determining

plans for production, distribution and use. If in the end the organizations received poor-quality equipment, it was not Gosplan's problem.

I developed a very trusting relationship with Ivan Selin. He led the American Management Corporation, a pioneering company in the use of information technology in the U.S. Once he came to Moscow on a regular visit, and I sent him to Gosplan to get familiar with our planning system. When he returned, he said that he had a very negative impression, and that this kind of planning would ensure the lag of the U.S.S.R. for some 20 years. It is easy to imagine what this meant in the years when Moore's Law just began to work. At the same time a powerful industry, headed by the Ministry of Radio Industry, had been created to replicate the IBM mainframe computers branded as "United Series"<sup>187</sup>. Thomas Watson, Jr., the actual creator of modern IBM computers, told me how it all happened. He was the U.S. ambassador in Moscow in a most unfortunate political climate, under Jimmy Carter. Nobody communicated with him, so we quickly became close and were friends until his death.

The issues of informatics had been discussed with Jermaine. Tom offered to buy several computers from IBM for industry and universities, similar to what we are going to do now with supercomputers, to educate the industry and to imbue in them a taste for new technology. "No," answered the omniscient Jermain "we need to start producing everything by ourselves." On and gone, and so

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<sup>187</sup> ES EVM (EC ЭBM, "Unified System of Electronic Computers") was a series of clones of IBM's System/360 and System/370 mainframes, manufactured in the Soviet Union and its satellites from the 1960s until 1998.

far we are still in captivity of this primitive thinking. Only now, the authorities have finally come to a recognition that the problem is not in the hardware but in the brains. We never could recognize that we have a brain disorder. Here we were always confident that we were ahead of the entire planet.

Electronics were developed by Minelektroprom<sup>188</sup>, (also by Ministry of Communications and Ministry of Device Industry), which was headed by a prominent engineer and organizer of the industry A.I. Shokin. I had developed a very good personal relationship with his chief aide Valentin Proleyko, also an outstanding man. By this time there were established centers in Zelenograd and Voronezh, and institutes and factories across the country. And the schools were strong. Academician S.A. Lebedev at the Institute of Precision Mechanics created a remarkable machine BESM-6 as the completion of an entire series, Academicians V.P. Glushko and A.I. Berg promoted the idea of global informatization and were creating an electronic government, and semiconductor science was also increasingly featured. The programming schools at the Institute of Applied Mathematics, in the Academy of Sciences' Computing Center and in the Novosibirsk Scientific Center were first class. But everybody was engaged with everyday affairs, and the government failed to hear the call of the future. To some extent the situation repeated the story of the seventeenth century, when during the year of the birth of Isaac Newton the Qing Dynasty came to power in China. China was technologically ahead of Europe, but isolated itself and for centuries has lagged

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<sup>188</sup> Ministry of Electronics Industry.

behind. That's why I insisted on the creation of a special branch of the Academy. Even my close colleagues did not understand this. V.I. Goldanskii with Y.A. Osipyan published an article in the newspaper Pravda saying that we needed new computers, not a new branch of the Academy.

In essence, no one supported me in the academy, except for Aleksandrov. Physicists thought that they would build by themselves all that was needed, mechanics and managers even more so, but the mathematicians were not united. So-called applied scientists supported the creation of a new branch, for example Academicians A.N. Tikhonov and A.A. Dorodnitsyn, as well as many very talented scientists, like N.N. Moiseev and O.M. Belotserkovsky, who did not see any prospects for themselves in the existing branches. We had a small group of allies and political support from the Party Central Committee.

When M.A. Suslov died, Yu.V. Andropov moved into his chair. I came to a meeting with him, and it was the only case in my life when the authorities had listened to me thoroughly, with no rush, and the decision was taken at once. Of course, Andropov was prepared for our talk thanks to his former position as the KGB chief; he was well aware of what was happening in the world, and assessed the situation in our country without illusions. "Now the bosses are resting in Pitsunda. When they get back, I'll take my place, and we will make everything work," said Andropov. But soon after our conversation, Andropov became the General Secretary, and all the accumulated problems fell onto him, including those that were linked to his health. I never met with him again, but I had phone access to him. I was actively assisted by his aides B.



Vladimirov and A. Volski, and we quickly became like-minded.

Despite the fierce resistance of the Premier N.A. Tikhonov and the Gosplan, the resolution on the development of informatics in the Academy of Sciences was adopted. In 1984 we opened the Computer Science branch at the Academy of Sciences and began to build the infrastructure. But, unfortunately, without Andropov.

At the Academy a group of enthusiasts for the mass use of computers began to take shape. It included the laboratory staff of V.M. Bryabrin from the Computing Center, V.B. Betelin from the MSU Mekhmat, A.T. Rakhimov from the MSU Physics Department, and others. The Moscow Computer Club was opened at the initiative of brother Pachikov, who later created one of the most successful companies, Parallel Graphics, and the future of computer tycoon Anatoly Karachinsky.

The first personal computers, the Commodore brand, were bought for the club by Garry Kasparov. This is how it happened. In the summer we took our younger son Paul to Zagulba because he needed the warm water of the Caspian Sea to help cure his kidney disease. At the same time Kasparov was there resting and being prepared to compete under the powerful tutelage of his mother. We met in the dining room, where we saw each other every day. Garry found me in Moscow, offered to help in the development of personal computers in the U.S.S.R., and became one of the main sponsors of the Moscow Computer Club. The club has played and continues to play an important role in attracting and educating Russia's youth, but this should be mentioned separately and in detail.

Through the Computing Center we were introduced to a very special scientist at the Massachusetts Institute of Technology, Professor Ed Fredkin. He is one of those enthusiasts who very sincerely and unselfishly wanted to help the Soviet Union to adopt the new revolutionary technology of personal computers, believing that socialism was ideal ground for its development and would have no choice but to use it. In the second idea he was right, and in the first, unfortunately, he was not. We published articles together, and sent notes to the Central Committee, but not very successfully. At that time the dogma of the superiority of hierarchical systems dominated, where instead of personal computers the users needed only terminals. By the way, as it often happens in technology, it is now, during the first decades of the 21<sup>st</sup> century, when we return to a similar idea, but now with the development of networks and a completely different level of microelectronics. Back then the development went in the opposite direction.

We tried to introduce personal computers into the schools. We struggled with the Minister for Education M.A. Prokofiev for an increase in state funding, for procurement of Yamaha computers and for the creation of our own production of Corvette, a personal computer developed by the laboratory of A.T. Rakhimov at the Institute of Nuclear Physics at MSU. In the end, we convinced everyone.

However, the government went on its standard ways of creating industry in the manner of VAZ<sup>189</sup>, ignoring the

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<sup>189</sup> AvtoVAZ is the Russian automobile manufacturer better known to the world under the trade name Lada. The VAZ factory is one of the biggest in the world, with over 90 miles (140 km) of production lines, and is unique in that most of the components for the cars are made in-house.

experience of world production, and going the way of so-called vertical integration. They cut down vineyards in Kishinev, Moldova, and a super factory began to be built, but it was too late: other countries, starting on a much smaller level, captured the world market and created a most dynamic industry. Eventually a personal computer broke through all the obstacles and came to our country, helping to build a number of private fortunes along the way. The Soviet system of industrial organization was inadequate to the new time, and we are still dealing with the consequences, primarily in the form of low productivity in our economy.

At the Academy of Sciences we tried to locally organize production of personal computers, software writing, and to provide education on the basics of computer science in schools. There were some individual achievements, but in general we could not fill the massive gap in the development and application of information technology. Analysis of the causes is beyond the framework of my memories; this is too serious a topic, and still most relevant today. However, the peculiarities of those years must be borne in mind as well. Copiers and printers had been under lock and key. And the personal computer brought the national borders to its screen, as was said figuratively by A. Soldatov.

In the late 70's an “Apple”, my first personal computer, appeared at my house. We installed the simple program "Sargon" to teach us to play chess. My younger son Pavel was 5 years old then, he did not read yet—neither

in Russian nor in English—so he learned the basics of the game himself, by trial and error. In the case of a wrong move the computer wrote "Syntax error". The computer continuously beat Pavel, which was very frustrating for him. But once he proudly called me in and showed the position on the screen. The game went on, but the computer did not have a king. I asked my son how he managed to take the king, since that is prohibited by the rules. It turns out that by some "mystical" way he was able to detect a complex command consisting of two steps. This command was intended to start the game, when the computer offers the choice of color for the player, and the player uses it to change the color. Pavel waited for the Check, changed color and took the king. Later, he perfected the tactic: he did not wait for the Check, instead he used the command after the computer was pretty much trashing him, changed color and continued to play starting with a winning position.

This way I gained an experience in the development process of the information revolution through a generation gap. Communicating with Pavel and the computer, I understood much about the interaction of natural and artificial intelligences. In the first stage of communication a computer is a toy for a child, then the child begins to treat it as an animate being, and at the final stage as an instrument. Today is the time for the so-called cognitive sciences, and perhaps the most significant events of our era.

The most characteristic event of the 1980s was the "great initiative"; that was a popular nickname for the death of Mikhail Suslov. Leonid Brezhnev followed him, then Yuri Andropov, Konstantin Chernenko, Andrei Kirilenko,

Dmitry Ustinov. And then the era of Mikhail Gorbachev began. But before that, there were some transitional periods. At this time, together with Jeremy Stone, Director of the Federation of American Scientists, we organized several programs. First came the training of the Soviet scientific community on the problems of arms control and strategic thinking (since the older generation, including L.A. Artsimovich, M.D. Millionshchikov, was gone and new people were needed), and secondly, we organized meetings and trips to the U.S.S.R. for the members of Congress, as well as for their assistants and advisers, which was extremely important.

One such moment I remember well. At that time, for obvious reasons, the high authority was unavailable. On this occasion, people joked "Today at 15:00, without regaining consciousness, Comrade X took office." Once, a powerful delegation of the Congress arrived. I remember B. Johnson, who headed the Committee on Energy, W. Cohen, the future U.S. Secretary of Defense (who gave me a book of his poems as a farewell), J. Biden, now vice-president in Barack Obama's administration, and a number of other equally influential congressmen. I was asked to entertain the guests, and I spent the whole day showing them thermonuclear installations at the Kurchatov Institute and at the branch in Troitsk, and invited them to my home in the evening. Subsequently, these meetings were very helpful for me in organizing cooperation in fusion research and in the creation of a joint project, the International experimental thermonuclear reactor (ITER).

I became fairly closely acquainted with Mikhail Gorbachev. At that time he was the Secretary of the CPSU

Central Committee on Agriculture, and then he took on the position of Yuri Andropov, the Secretary of Ideology and Science of the Central Committee. My active cooperation with Arkady Volsky and Boris Vladimirov, the assistants of Yuri Andropov, had begun.

A notable event for me was a trip with Mikhail Gorbachev to England to see Margaret Thatcher. Gorbachev had a fairly large delegation with him, I was representing the science portion, and a poet F.I. Chuev represented the arts. Gorbachev came in the difficult role of the "Crown Prince". A lot has been written about this trip. I want to mention the meeting with members of Parliament and Government, and parliamentary visits. At this time an extraordinary event happened there. During a meeting in the Parliament, as usual, the great Rod, a symbol of the speaker's power, was brought in. A member of the Labour Party, in protest, picked it up and threw it on the floor. The Speaker had deprived him of meeting participation rights for a certain term. In connection with this event I recall a story about Winston Churchill and his opponent, Lady N. Astor. One day Churchill came to the meeting tipsy, and Lady Astor said, "Sir, you're drunk." He replied, "You are ugly." "You're drunk, Sir!" repeated Lady Astor. "Tomorrow after a good sleep I will be sober, but you will still be ugly," countered Churchill. Or another anecdote, while eating breakfast Lady Astor said to Churchill, "If you were my husband, I would poison your tea." He retorted, "If you were my wife, I would drink it." Another episode in the life of Churchill: Once he was visited by members of the temperance society in his office in Westminster. They said, "Mr. Prime Minister, we calculated that if all the

cognac that you drink would be poured into your office, you would stand to your belt in cognac." "Good job," Churchill noted, looking at the high walls and ceiling. "But there's so much more to be drunk!"

In London, the "Bobbies" guarded us in the hotel hallway. One night, I heard someone knock persistently on the door to the next room. I got out of bed and saw Chuev. He had drunk quite a bit before going to sleep, got up at night, and by mistake instead of going to the toilet room went to the hallway. The door slammed shut, he stood in front of the door naked, and the "Bobby" pulled his helmet over his eyes and pretended to be asleep. I asked, "Why are you knocking, is anyone there in the room?" He replied, "No, but what can I do?" I let him into my room and went down to the reception for the key of his room. They were not even very much surprised: the Russians, what to expect from them?

We went to Edinburgh. There we were greeted with the news of the death of Dmitri Ustinov, and Gorbachev quickly went back home. The frustrated host only had enough time to explain to me how to cure a cold: you fill one third of a cup with boiling water, one third with tea, the rest with whiskey, drink and quickly go to bed. Good recipe; I use it still today. The museums of London, the British Library, the Tower, the bridges across the Thames River and other sites I have visited many times during my business trips and travels with my wife. Musicals, restaurants, pubs and bars... Double Decker buses... Crowds of young people in Piccadilly... I am very fond of London, the London of Dickens, the Pickwick Club and Oliver Twist.

During the short "reign" of K.U. Chernenko I did not have any special contacts with him, as it was the prerogative of Y. Ovchinnikov. I remember one typical episode. I was skiing in Armenia with the kids. Suddenly, I was urgently summoned to Moscow for a Politburo meeting on education issues, including computer education. In the morning I arrived at the Old Square, and there was still time, but as I went to the entrance, they told me "Not here, in the Kremlin." I ran to the Kremlin and thankfully, after the mountains, I had a lot of hemoglobin in my blood. At the last minute I rushed into the room and sat next to N.E. Kruchina. The sweat was running on my face. Soon they turned to "my" issue. Chernenko immediately asked the members of the Politburo, "Is all clear?" They respond in unison, "Everything. Accepted. The issue has been decided." As compensation, I became witness to the historic discussions on convening a long-overdue plenum on scientific and technological progress. Several times they tried to call the plenum, and each time it did not work out. Gorbachev reported the status and proposed the agenda. N.A. Tikhonov raised and declared that the issue should be discussed in the context of five-year planning. Chernenko enjoyed the strife and took a wise decision to postpone the issue. Ultimately this was decided by Gorbachev at a meeting in April of 1985, after the death of Chernenko.

After the meeting, I returned to Tsihadzor with some adventure: Yerevan did not take our flight, we had to land in Tbilisi. After a usual luxury dinner at D.G. Lominadze, where I broke another tooth, I was driven by car to



Tsihadzor. The skiing experience was a nightmare. There was almost no snow, only ice and rocks. The lift went over an abyss and I had Pavel in my hands, in a slippery suit. The weather was disgusting. At the top lift there was no one on duty. On the summit Pavel's skis were caught under the chair, and the safety chain would not unfasten. He was going to break his back. Thank God, our friend Natasha Chernukha was nearby, and she was able to pull my son from his chair at the last moment. Nevertheless, I retain fond memories of Armenia, with its Echmiadzin, ancient temples, and Yerevan.

During these years, Tbilisi and Yerevan competed in their ancient history. A joke of the time said that the archaeologists, while digging in Yerevan, found a piece of copper wire and concluded that 3,000 years ago there was a telegraph in Armenia. The Georgians were digging and digging, but found nothing. Therefore they concluded that 5,000 years ago there was already a wireless telegraph in Georgia.

In Yerevan, we were invited to a plant that produced wine and brandy. It was said that this plant was visited by the Catholicos<sup>190</sup> who said "You have divine Brandy, but the prices are ungodly." Now everything has changed, the cognac became godless, and prices have risen to the skies.

In those years, together with my wife and children, we visited many ski resorts in the U.S.S.R.: Cheget, Dombay, Elbrus. Given the quality of gear and clothing, it was a heroic endeavor. The situation has improved somewhat with the opening of Gudauri.

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<sup>190</sup> Catholicos are the heads of certain Eastern Christian churches, particularly in Armenia.

A new era began with the death of Chernenko - the era of acceleration, *perestroika*, *glasnost*, the end of the Cold War and the collapse of the Soviet Union. And on that historic day in March, when the Politburo discussed the candidate for the committee chair for the funeral, i.e. the successor to the Secretary General, I stood along with Kruchina on a flight of stairs between the 4th and 5th floors of the CPSU Central Committee building, and waited for the outcome of the meeting. I do not remember who came out and said, "Gorbachev". I went to see him in the 5th office, one of Stalin's studies. I was probably one of the first who congratulated him. It was a feeling of a great hope. We had a short talk about the future. A new era had indeed begun.

Formally, my position did not change, but the possibility of direct contacts with Gorbachev, of course, opened up new opportunities. And prospects for changing the system opened up as well. I was not taking part in the political debate directly, though I was elected first as a candidate, then as a member of the CPSU Central Committee, and was in the so-called "Red Hundred", the Supreme Council. When Gorbachev began dealing with real problems, I was invited to join the Presidential Council. This meant that the end was near; I had never been an assistant or an advisor to presidents or general secretaries.

Acceleration, *perestroika*, *glasnost* and democratization have been wonderful surprises for me, and the pace of changes was totally unexpected. Internally, I

was fully prepared for this, but I did not have the real intellectual training and the appropriate level of education. I had education in the spirit of early twentieth century liberalism, plus some vague ideas similar to Sakharov's thoughts about the connection of the systems. But there was a significant life experience, not only mine, but in my surroundings, an experience of not just a simple cooperation, but a full spiritual unity in the informal international scientific community. It should be borne in mind that my position, and that of my friends, was very sensitive. Our involvement in defense projects, especially in Sredmash and at the Kurchatov Institute, demanded strict observance of secrecy, inner belief and discipline. But the positions of my foreign colleagues were similar, and I did not have, in this area, any moral concerns or problems with the regime. Another matter was ideology, and there a split was real and imminent. I did not hide this from my foreign friends, and they saw everything with understanding. For example, my great friend and supporter Father Hesburgh, the rector of the Jesuit University of Notre Dame, in the final year before his retirement elected me an honorary doctor of jurisprudence. I was, and remain, a complete layman in law, but at this time I was also a full member of the CPSU Central Committee. With me were elected David Rockefeller, the wife of Martin Luther King Jr., VIP Republicans from the Congress, and the Presidents of Coca-Cola, the Pontifical Academy, the University of Cambridge, and in the previous year President Ronald Reagan. I do not believe in God or in Karl Marx, and do not particularly hide this. But I have always been a patriot of Russia, even though I view Russia as Lermontov:

I love my homeland, but in the strangest way;  
My intellect could never conquer it.  
The fame, earned with my blood and pain,  
The peace, full of the proud fit,  
The dark old age and its devoted tales  
Won't stir in me the blithe inspiring gales.<sup>191</sup>

Thus, going with the flow, I tried to take advantage of new opportunities to address the problems that were important for Russia, as I felt my way along with my confederates.

First of all, it was Russia's industrial development of information technology, what is now called innovation development. I found a number of talented colleagues at the new branch of the Academy, and, together with Volodya Betelin, launched a pilot project in the ZIL automotive factory. It all began with the introduction of laser technology, which soon had some real serious achievements, but the next step was more fundamental, the introduction of computer simulation and design. We started creating software, but it turned out that in the U.S.S.R. we could neither produce nor acquire the appropriate computers in needed quantities. Betelin proposed to develop a new type of massive computers, so-called *workstations* that had just barely began to emerge in the world.

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<sup>191</sup> Mikhail Lermontov, *Motherland* (1841), Translation by Boris Leyvi.

Vladimir Betelin, who graduated from Mekhmat at MSU, combined the unique properties of a scientist, engineer, manager and entrepreneur. In ZIL there was another unique person, director P.D. Borodin. As a result of the cooperation of Betelin and Borodin's team, a unique Soviet workstation BEST was created. It was so named after the two designers of the project, BEtelinSTAvitsky, and that was really the "best". Also a research and production complex was created, which has survived all the upheavals since. ZIL received the required 300 stations. At this time, the Soviet machine building industry was already falling into a tailspin (this was the end of 1980s), and the factory sold all the stations. Profits from the sale exceeded the profits from all the main products. One could build a successful business on these workstations, but it was so unique that it did not fit into the existing manufacturing model, and the new bosses of ZIL shut down all the production because of fear. Borodin already left the factory by this time. So the movement, which began at the April meeting of the CPSU Central Committee with a motion to modernize the industry and to accelerate scientific and technological progress, at first evolved brilliantly, then ended in that very characteristic way of Gorbachev's *perestroika*. As Chernomyrdin said once, "We wanted the best, but it turned out as always." Now we began almost everything anew.

The second important event in 1985 for my affairs was Mikhail Gorbachev's visit to France, his first official travel abroad as the General Secretary. Before the trip, I offered to put forward an international project, a joint design, development and construction of the International

experimental thermonuclear reactor, Tokamak. As I already wrote, we were, together with the U.S., Japan and Europe, developing the concept of such a reactor since 1978, but could not go beyond the conceptual stage due to the political situation back then. Now there was a chance. I must say that the United States, Japan, and Europe, in the framework of the Versailles Summit, began a similar project, but due to internal competition they got stuck (we, later in the process of working on the ITER project, many times would be confronted with the same pitfalls). When before my visit to Paris I told the idea to Michael Roberts at a meeting of the IAEA in Vienna (he actively participated in the Versailles Summit and in the INTOR project), he told me firmly that nothing will come out of the proposal. But Gorbachev picked up the idea, he took me with him to see F. Mitterrand and J. Chirac, and they also supported the idea, and presented it to Ronald Reagan. Thus began a project with a unique outreach of participants; today it is the United States, Europe, Japan, Russia, China, Korea and India; more than half of humanity.

In the same year I celebrated my 50th birthday, just before the beginning of Gorbachev's prohibition law. We celebrated the occasion in the Orlyonok hotel. The day before, I had returned from Athens, where I was at a meeting of leaders of the Non-Aligned Countries that had signed a declaration on nuclear disarmament and cessation of nuclear tests. There I was a guest of our Ambassador Igor Andropov. I brought back a huge bottle of Metaxa, which, together with an equally huge bottle of 50-year old brandy from Yerevan, were the main attractions of the birthday party. From Gorbachev I received a Gold Star of

the Hero of Socialist Labor<sup>192</sup>, rightfully or not is not for me to judge, but this Star still helps me in my daily affairs. In the Politburo not all agreed with this rewarding; G.V. Romanov objected. In connection with my increasing influence, I began to acquire powerful enemies, from the Institute and up to the top authorities, which is quite natural.

Immediately after the appointment of Gorbachev as the General Secretary, I asked him to read a report on missile defense, commissioned by Ustinov. It seems to me that the report is still of interest today, but so far I am not able to find it, it is still classified. Perhaps now it is easier to find it in the U.S. I hope that this report has influenced the strategy of asymmetric response, announced by Gorbachev at the summit in Geneva. In the Soviet Union, around the Committee of Soviet Scientists and the Academy of Sciences, an active group developed in this time. Roald Sagdeev (he was then director of the Institute for Space Research at the Academy of Sciences) and Andrei Kokoshin (who was then working at the Institute of U.S.A. and Canada) along with other colleagues became the core of this group. We collaborated with the Federation of American Scientists (Frank von Hippel was the President, and Jeremy Stone was the Director) and with the Union of Concerned Scientists. Jeremy had already taken advantage of our statement on SDI during a debate in Congress. We decided to conduct joint research on missile defense and weapons in space. But the issue was sensitive. On the one hand, we could be accused of leaking classified information ("selling the motherland"), which, of course,

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<sup>192</sup> Hero of Socialist Labour was the highest honorary title in the Soviet Union.

happened in the U.S.S.R. and in the United States, on roughly the same terms. On the other hand, our joint work could be easily announced as a mere translation from English, because in the U.S. it was a lot easier to write and publish such work. Therefore, we decided to write and publish independently, with public education as the main goal, since in the U.S.S.R. almost no information was available in the print media. In the United States a usual mixture of military and industrial advertising, schizophrenic fantasies of General Keegan and various columnists had been published in abundance, which is still so familiar to us even today. We proceeded from the idea that physical laws in the U.S. and the U.S.S.R. were the same, and our analysis was based only on physics, without using any confidential information. A permission to publish was received from Glavlit<sup>193</sup> with great difficulty. Toward the close, they wanted us to make a statement under every conclusion that this was a view of American scientists.

During a trip to the U.S., at a reception at our embassy for the delegation of the National Academy of Sciences of the U.S.A., I met with a journalist from The Washington Post, Bob Kaiser, and offered to write an article for his column. He replied that it would not work for three reasons: firstly, the article was needed that day, and I would send it in a year. Secondly, the article was needed in English, and I would write it in bad Russian, and third, most importantly, I would write for Pravda, and he needed the article for The Washington Post. I boldly answered, “Tomorrow morning, in English, for The Washington Post.” All night long we worked, I wrote, and Kokoshin

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<sup>193</sup> Glavlit was the main censorship agency in the U.S.S.R.



with the guys from the embassy translated. In the morning we carried the paper to Kaiser. It took him three months to obtain the consent of the editorial board to publish it. When we met with him next time in Moscow, he told me what a scandal arose after the publication. In letters to the editor he was accused of selling the country and his action was compared with a hypothetical publication of an article by a German author who denies the reality of radar on the eve of the start of the air war over England. And all I did was honestly describe the systemic problems of creating anti-missile weapons based on new physical principles, and the technical level of available means. In particular, I wrote, "If you want to try it yourselves, take the most modern and powerful laser and a targeting system, go on a duck hunting trip, and try to shoot down a duck." As we have lived in a virtual world of myths and fantasies, we still live like this up to now. The attack on the mind only grows.

Then, in *The Washington Post*, I helped the journalist Flora Lewis write an article in support of the International Thermonuclear Reactor. This article helped in the Congress and the Administration to begin the ITER project.

In the same year at the Academy of Sciences, we started a new non-governmental project to prove the possibility of verifying compliance with the treaty on the cessation of underground nuclear tests. In principle, following the Treaty on the Nonproliferation of Nuclear Weapons, all major nuclear powers committed themselves to stop the tests, but the developers and the manufacturers of nuclear weapons fiercely resisted. In Geneva,

negotiations continued over the years, but the end was not in sight. The main argument against the treaty came up from Edward Teller in the phenomenon of so-called "decoupling". According to his theory, if a nuclear warhead was to blow up in a special cavity, the energy released by the explosion produces an acoustic wave propagating outwards that may be so reduced that the existing geophysical seismograph devices would not be able to register the fact of the explosion. This argument was aided by the dispute about compliance with the treaty on the limitation on the quantity of underground explosions up to 150 kilotons. The Americans argued that in our tests in Semipalatinsk we exceeded the threshold by a factor of two. So there we were standing stuck for a few years, leaning into each other's horns.

As I wrote, at a meeting of academic researchers we recognized the importance of ending the tests. In the U.S., many politicians and public figures, including Edward Kennedy in Congress, supported this idea. It was also supported by the organization called Physicians for Nuclear Disarmament, which was headed by Evgeny Chazov<sup>194</sup> and renowned American cardiologist Bernie Lown. They invited me to a conference in Holland, which discussed the issue of Soviet-American confrontation, and we came to the conclusion that there was a strong alliance between American militarism and Soviet super-secrecy, a very effective synergy. To stop the spiral of the nuclear arms race, that union must be destroyed. From this point an idea of military transparency and reasonable openness

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<sup>194</sup> Evgeny Chazov (born 1929) is a prominent physician of the Soviet Union and Russia, specializing in cardiology.

developed. I delivered this idea to Mikhail Gorbachev, and it was supported by S.F. Akhromeev and G.M. Kornienko. At a meeting in Copenhagen on the anniversary of N. Bohr, with the consent of Mikhail Gorbachev, I proposed the creation of a non-governmental network of seismographs for demonstrating the feasibility of such verification. This idea was supported by the International Organization of Parliamentarians for World Order, headed by O. Grimsson (now The President of Iceland), and then by an American environmental organization called the Natural Resources Defense Council (NRDC).

A very energetic American, Tom Cochran, headed the project. We conducted the first workshop in Moscow and signed an agreement between the U.S.S.R. and the U.S. NRDC. Tom mobilized American charities and secured financial support in a very short period of time. By the summer everything was ready, and the American scientists with their instruments were already in Kazakhstan, some 300 kilometers from one of the most secretive places in the world. Then Chernobyl exploded, and I for some time was taken off the project, but the project continued to move forward. Mikhail Gorbachev announced a moratorium on nuclear testing, however the Reagan administration tried to avoid a moratorium.

To allow American scientists to work near Semipalatinsk, it was necessary to arrange a special decision from the Politburo. I made preliminary arrangements with A.F. Dobrynin, who became secretary of the Central Committee on Foreign Affairs, L.N. Zaikov, responsible for defense, and V.M. Chebrikov from the KGB. The Politburo meeting was very difficult, the

Chernobyl issues were discussed, and everybody was quite tired. When the Chernobyl agenda was finished, Gorbachev announced the issue of Semipalatinsk. And to my amazement, all my friends who previously supported me suddenly began to express doubts. These doubts had arisen in the past, but we had discussed them all and had come to a joint compromise decision. And suddenly such a turn. Then I recalled how Gorbachev explained to me the meaning of collective leadership, when each person separately supports an idea, and all together are against it. The only one who supported me, quite unexpectedly, was E.P. Slavsky, but after the Chernobyl accident nobody really listened to him. After everyone left, I stayed and asked Mikhail Gorbachev what to do now. He, in his now well-known manner, told me to interpret as you wished. The treaty with the Americans had already been signed, the Americans with their instruments were near Semipalatinsk, so I could be easily sent to the camp. I knew it all, but continued to operate as before, thanks to the fact that I already had an agreement with the government and local authorities. Why all my supporters had betrayed me and conspired amongst themselves, I do not know. I was not allowed to have access to the special documents of the Politburo. Only recently I received from the Americans a copy of a top secret document, where the same friends described similar concerns and told the authorities that I was all wrong. Nobody reported this fact to me back then. It was an interesting time...

We completed the project in two years and proved a possibility of detecting explosions from as little as a single ton of TNT. We explained the reason for the disagreement

with the Americans in the measurement of power of nuclear explosions at the Semipalatinsk test site by measuring the attenuation of seismic waves in the solid rock at the Semipalatinsk nuclear test site versus the sand in Nevada. In the latter case, the attenuation was exactly 2-fold stronger. But that was only after we received permission to work in Nevada, having passed through many similar obstacles in the U.S.S.R. Initially, the State Department refused us visas, explaining the refusal by arguing that the verification was too important of a matter to trust it to private scholars. Richard Perle at the Pentagon came up with quite a Jesuit solution; he agreed to a joint demonstration, but only using the so-called Cortex method, which required placement of instrumentation at a distance of 50 meters from the blast mines, an accurate knowledge of the time of the explosion, and worked just above the threshold of 50 kilotons. So, this method, in principle, could not be used toward the control performance of the agreement on cessation of tests. This fact not only prevented us from finishing the work, but also gave the trump card into the hands of our enemies, and we had quite a number of them.

Once at the Politburo the head of the 12th General Directorate of Defense directly accused me of treason, because I let the Americans within 300 km of our test shafts, and they, in violation of the treaty between the Academy of Sciences and the Natural Resources Defense Council, did not allow us to Nevada. (A year later the very same person enthusiastically allowed Americans to the very same test site within 50 meters of the shaft, within the framework of the widely publicized and completely

senseless joint project Cortex of the Ministry of Defense and the Pentagon). The Council was powerless to fulfill their obligations, but the cessation of work would be only handy for the American "hawks."

At this time Charles Vick, a director of the American news agency, appeared in Moscow. We had him dubbed as the American Goebbels, and none of the responsible people dared to meet with him. I, however, met him at the Academy, and we established a very good personal relationship. He turned out to be a wise man with a sense of humor. During the meeting, I said, "Charlie, your administration has denied the right to private initiative to your scholars and to ours, while the President, on the contrary, all the time emphasizes the role of private initiative. This is a contradiction. What do we do?" He replied, "You write a letter to him, and tomorrow I will see him in Athens and will pass him the letter." I immediately wrote, and a month later we received permission for our experiments in Nevada. Together with our American colleagues, we set up seismographs, conducted a series of chemical explosions and completed the work. It greatly influenced the debate in Congress regarding a treaty on the complete cessation of nuclear testing and the signing of this treaty, although the treaty was not yet ratified by Congress and the work is still ahead. In general, this is one of the positive examples of the real contribution of civil society in addressing global problems. In Russia, this has led to significant improvement in the culture and level of deep seismology probing.

During the experiments in Nevada, we lived in Reno, *The Biggest Little City in the World*, in a newly built

casino. After Las Vegas, Reno is the second gambling capital of the United States. I was greeted very warmly; they even elected me an honorary citizen of Reno. I moved through Nevada around the test sites on a small two-seat helicopter. The pilot was a Vietnam veteran; he showed me the technique of aerobatics. The helicopter was like a plastic ball, it was clear up, down and sideways, and when it was diving on a pack of coyotes, the sensation was breathtaking. Nevada looks like a large children's sandbox, from which in some places the mountains protrude here and there, and the semi-dry salt puddles gleam. One of our stations was located in a river valley, from which all the water was diverted to Los Angeles. Vegetation, livestock and humans have almost disappeared. Once we saw a family of gold miners, a father, a mother and a daughter, all pretty young, but awful looking, in the midst of the lifeless desert. We landed near them and left them a box of beer. In general, it was very interesting, and a different side of America.

My stable and intense life was gradually moving along. The ITER had been successfully designed in Garshing. I was elected the Chairman of the Board of Directors, and a wonderful Japanese scientist and engineer Ken Tomabechi was invited to be the Director of the project. He had just finished a number of major nuclear projects and enthusiastically took up this new one. Experimental facilities for nuclear fusion research were under development, including a superconducting Tokamak T-15 as a prototype of the ITER at the Kurchatov Institute,

a pulse Tokamak with adiabatic compression of the TSP at the branch in Troitsk, a pulse installation *Angara* in Troitsk, a laser installation *Iskra* in Sarov and two laser systems at FIAN<sup>195</sup>, which was split into two institutions, one under N.G. Basov, the other under A.M. Prokhorov. The latter also had the stellarator and the open trap in Novosibirsk. A new branch of the Informatics and Computing Technology at the Academy of Sciences began its work. Under the order of the Central Committee and the Council of Ministers, the infrastructure of this new branch was created: a specialized Institute for Software Technology in Pereslavl, the first in the U.S.S.R., a Center in Yaroslavl, and a number of other institutions. Together with the K.V. Frolov we began to create a branch of Mechanical Engineering. And then the Chernobyl accident happened.

V.A. Legasov was the first deputy of Aleksandrov at the Institute, responsible for the development of nuclear energy. Outsiders were not often allowed into the "holy of holies"; on this issue M.D. Millionshchikov and N.N. Ponomarev-Stepnoi, his deputy, had problems. The plasma physicists, including myself, were not involved in this subject. On the way to work, I met Legasov. He said that something has happened at the Chernobyl station, and he was going there. Already at the Academy of Sciences Y. Izrael, who was responsible for Rosgidromet<sup>196</sup>, was talking about the radioactive cloud, and it became clear that the events were taking a serious turn and would require the participation of all the scientific strength of the Institute.

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<sup>195</sup> FIAN – the Lebedev Physics Institute of the Russian Academy of Sciences in Moscow.

<sup>196</sup> Rosgidromet - Russia's Federal Service on Hydrometeorology and Environment Monitoring.



Knowing the aftermath of the accident of the U.S. nuclear power plant at Three Mile Island, we began an investigation of the possibility of penetration of molten fuel through the barriers. We decided to immediately begin the experiments with high-power lasers and calculations. Today we know that the fuel in the reactor penetrated deep through the concrete foundation but, fortunately, did not work its way outside the building and did not get into the groundwater. Based on these studies, we proposed to urgently build a trap underneath the fourth block, which was done in record time thanks to the heroic work of miners, with the most involved participation of the Minister M.I. Shchadov. The fuel did not reach the trap, so later we were blamed for its construction, but now such a trap is an integral part of the safety of nuclear power plants.

Around April 28th Frank von Hippel called me and advised me to check whether people, and above all children, in the accident zone received iodine tablets. The fact is that radiation has an insidious ability to concentrate. In this case we were talking about radioactive iodine. Escaping from the destroyed reactor to the atmosphere, iodine falls on grass with the rain, the cows eat the grass, and from the milk the iodine gets into human intestines, blood, and concentrates in the thyroid gland. This can lead to very high doses and, eventually, can cause cancer of the gland. Iodine tablets saturate the gland with non-radioactive iodine, thereby preventing the accumulation of radioactive iodine. I called Ivan Stepanovich Silaev, and he invited me to a meeting of the governmental commission immediately after the May parade and demonstration. On the committee there was the deputy of Health Minister and the Chief of

Civil Defense. They stated that steps had been taken and all who were in need were already receiving the tablets. Regrettably, it was not true, leading to very unfortunate consequences.

After the meeting Prime Minister N.I. Ryzhkov, saying that members of the governmental commission received a dose of radiation and they needed to be changed, dispatched Silaev, as deputy President of the Council of Ministers, and me as an organizer of scientific support. As they say, I came from the frying pan into the fire, as I did not have admission to the nuclear reactor at the Institute, and as an engineer-lieutenant in my military profession<sup>197</sup> I had only a theoretical understanding of the effect of radiation and radiometry. I had to learn everything on the fly, as in 1941, when many learned the skills to fight at the front. Unfortunately, later there were many similarities between the unpreparedness for the disaster in April of 1986 and in June of 1941. I drove home and left a note to my wife, who at that time was at the dacha, saying, "I have gone for a couple of days to Chernobyl." I returned in six weeks. I could phone Mikhail Gorbachev from there, but I was forbidden to call home, so my wife was fed by the most terrible rumors until I returned.

I flew on an airplane with a very sweet and intelligent Marshal, a commander of the Corps of Engineers. When the next day we were inspecting the station, for both of us everything was a surprise. According to the handbook for working with radioactive materials, they should be inside, and we should be outside. In fact, everything turned out to be the opposite, everything around us was radioactive, and

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<sup>197</sup> In the U.S.S.R. many scientists had military profession and officer's ranks in the reserves.

the level measured not in micro-roentgens but in roentgens, up to hundreds and thousands. I asked the Marshal, "How would we act in a military situation?" "Go around," he responded. But we needed to get inside to sort everything out.

In Moscow the experts were calculating the temperature of the reactor and the moment when the support structures would fail, and here we were trying to come up with a quick estimate. On the third day, coasting around the block on the helicopter, I was able to look inside the reactor core that was illuminated by the light of a burning parachute flare that was dropped into the hole. I saw that there was no reactor; the top plate, weighing three hundred tons, stood almost vertically, with nothing underneath. Silayev was shocked, as was Moscow. Only a few years later, when we drilled holes into the protective shield of the reactor and shoved in a video camera, we became convinced that the bottom plate brought down the supporting structures and fell down immediately, so that the reactor had not existed since the beginning. We were especially worried about the possibility of a second steam-ejection in case the overheated fuel would fall into the pool under the reactor filled with water after the first explosion. It was at this time that Gorbachev asked me, "Should we evacuate Kiev?" I could not give him a definitive answer until, thanks to the heroic efforts of station staff, who worked to their waists in the radioactive water, it became possible to open the valves and drain the water.

Where was the fuel, together with the accumulated fission fragments and the plutonium? This issue was most important to us. To find an answer, we organized to

measure levels of background gamma radiation outside the station throughout the contaminated area, as well as the measurements inside. Outside, we mostly used a helicopter, but from within, of course, it was all on foot. I tried to use Gorbachev's own special tank, but nothing particularly useful came out of it, since the radiation levels near the destroyed unit had reached hundreds of roentgen per hour. Our stay at the station was determined by the doses we received and was shrinking with each day like shagreen leather. We set for ourselves a limit on the level, about a hundred roentgen, based on our experience at the Institute. It was an individual's own decision; the officially permissible doses were many times lower. During one standard visit to the unit we usually would get up to one roentgen, although it was quite often a guessed value due to the imperfections of dosimeters, the inhomogeneity of the radiation field, and the unknown contribution of the internal exposure. I was vindicated when I visited Hiroshima; the Japanese tested my blood, determined the proportion of damaged chromosomes and within a deuce confirmed the level of my own estimations.

Many years have passed since systematic mapping of background gamma-ray radiation in the vast territory has been carried out. It had to wait until the measurements of alpha activity were completed, which was technically a very challenging task, particularly for plutonium, and until all the main rooms were examined, where the liquid lava penetrated through the cracks, the passageways, and through the concrete floors. It took the heroic effort of scientists and workers from the Kurchatov Institute and other institutions of Sredmash and the Academy of

Sciences - completely voluntary and selfless. I must say, during this period one could call any Soviet organization or factory, any local authority or party boss, and instantly get any, even the most exotic assistance. For some time the spirit of the brotherhood of the front lines came back:

"Everything for Victory!" Politicization and commercialization came later, and we all became members of the *Roadside Picnic*<sup>198</sup>, one of the most prophetic and profound fantasy novels of our time. "Stalker" has become a favorite movie in the zone.

Thus, the duration of my stay was determined by the dose. As I said, N.I. Ryzhkov sent me there, without any formalities, and I stayed there with I.S. Silaev, Y.D. Maslyukov and L.A. Voronin. We arrived with I.M. Shchadov and the Marshal at night. They were stationed elsewhere, but I stayed the night at the headquarters, which occupied the building of the City Party Committee and the City Council. As I recall, there was nobody there, and I slept either on the chairs, or on the table. All night the telephone rang, the evacuation of the population began, and poor townsfolk asked me a bunch of questions. I had to respond since I was on the staff, I tried to answer using common sense, though even now I'm not sure that I, and the rest of the team, had common sense back then. Confusion was complete, no one really knew what happened. As in the beginning of the war...

B. E. Shcherbina, as the Vice Premier in charge of energy, discussed the plans for bringing the fifth block online. From Moscow, they were demanding we measure

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<sup>198</sup> *Roadside Picnic* is the well known science fiction book by the Strugatsky brothers, also known for the computer game "Stalker" and movie by the same name, both inspired by the book.

the temperature of a reactor that almost did not exist. In Kiev, V.V. Shcherbitsky organized a public rally to calm down the population (!) and at night I was trying to figure out what would happen to the livestock. I was asked by the people of Chernobyl about this. In the West, they have already written about the tens of thousands killed in the accident. I. Morozov, the first deputy of E.P. Slavsky, was preparing on behalf of Sredmash an excusatory report. In the morning we went with the Marshal to the station for reconnaissance. The damage was minimal, but the dose was monstrous. I asked the Marshal once more how they would deal with such objects during a war. "Go around," he replied again. It is possible to go around a contaminated site, but impossible to go around a cloud of radioactive dust.

The liquidators began to dump sand into the reactor shaft, and then decided to drop the lead shot into the core, which was not the wisest decision. They began to think about fixing the dust and protecting the groundwater. I called the director of the largest chemical institute in Leningrad, the Academician B.V. Gidasov, and he made a very sticky resin. We covered the block with this resin, and as we poured we were glued to it like flies to a sticky paper, and our feet became desperately contaminated. The resin was expensive, so energetic and practical L.D. Ryabev organized production of a similar resin from auxiliary materials, and it helped greatly for fixation of radioactive dust. Silaev began discussing with his aviation colleagues a construction of a sarcophagus, and V. Pismenny together with the Minister of Coal Industry, I.M. Shchadov,

immediately upon arrival discussed construction of the trap beneath the unit, which was then built by the heroic miners.

The weather was perfect, the gardens were in bloom, and the sight of the city, abandoned by its residents, the sight of dogs and cats that were left behind, brought people to tears. The ancient town, peaceful and soulful Gogol's Ukraine, where Ukrainian songs sounded for centuries, and supreme Jewish wisdom found refuge. The departing folks asked, "How soon will we be able to come back?" What could I answer them? I replied, "Never!" On the other hand, the traditional Soviet super-secrecy clearly had a damaging effect. I called A.N. Yakovlev and asked him to send the press, including foreigners. The result was unexpected. In the evening, A.M. Petrosyants called, he was something like a nominal chairman of Atomic Industry of the U.S.S.R., and informed Silaev and me that an "auditor" was coming, Hans Blix, the General Director of the International Atomic Energy Agency, and M. Rosen, his deputy. According to the Moscow plan they would fly to Kiev and from there would be driven by car to the Chernobyl site, we would tell them everything, and they would come back. I was horrified. Why go to Chernobyl for a talk? You could tell all in Vienna, the question is would they believe it? Especially on the way, they would be exposed to both radioactive dust and to the worst rumors. Petrosyants asked, "What should we do?" I replied, "Put them in a helicopter, fly them over the station, they will see everything, and we will tell them all on the way." "No," he said, "it's impossible, there is a secret object on the route, and the KGB is opposed." I knew what the object was, so I said, "Everyone has already fled from there." But

Petrosyants did not agree. Silaev said, "Call Gorbachev." I could not call home to my wife for two weeks, but I was connected with Gorbachev in his car at once. I was in a panic, thinking, "What can I say?" He is a man from the south, he knows the local conditions..." I said to Silaev, "Tell him that our outhouse is full, and people have to go through a pile of crap." Silaev was a straight man, and he said exactly what I had told him. Gorbachev groaned, but agreed with my plan.

A few days later V.A. Sidorenko and I flew by helicopter to Kiev to pick up Blix and Rosen. In Kiev, we were met by Ukrainian colleagues who told a bunch of jokes to relax the tension. By now many of these jokes have become classics, and I apologize to the reader, but I will repeat some of them. The first one is simple: "Finally, a peaceful atom went into every house." And another one, prophetic: A man from Kiev met in heaven a man from Chernobyl and asked him, "How did you get here?" He replied, "Too much radiation. And you?" The man from Kiev answers, "Too much information." Misinformation indeed has brought much harm to the health and welfare of citizens in the Ukraine, Belarus, and throughout Russia, as well as throughout the world. Many have practiced in the composition and distribution of fables, making their names, political careers and money.

We took Blix and Rosen to the helicopter. Because of the summer heat, we were sweating in our cotton clothes, with pathetically primitive electrostatic dosimeters. They were wearing luxurious protective clothing, hung with trendy electronic toys. Rosen asked, "What range should we set?" I answered, "A hundred." "Milliroentgen?" he



asked. "No," I said, "Roentgen." He was somewhat uncomfortable, and said, "I do not have such a range." "Well, no worries," we answered. "We've got this range, and we know the rule of thumb, we are flying there every day." In actuality we did not know, and in particular, we did not immediately see why near the fourth unit the radiation level did not fall on the inverse square of the distance from the reactor, but considerably slower. It turned out that the radiation was coming from residues of fuel ejected during the steam explosion and the burning of graphite. Those fuel residues were deposited on the structure of the smokestack.

But we were not going to over-expose our guests, and we were not in a hurry to get overexposed ourselves. We flew to the station. This picture is now widely known. I asked Rosen, "Do you want to come closer?" "No," he said, "from here all is well in sight." The station as a whole looked intact, people down there were working, and no tens of thousands of corpses were to be seen. We landed on the outskirts of Chernobyl and returned to Kiev. We gave quite complete, truthful and accurate information.

TV reporters and filmmakers began to appear. With Y.D. Maslyukov a team of K.D. Sinelnikov arrived, and they wanted to get inside the station. I had just gone inside with B. Pismenny to check where the thermocouple cable was dropped. The thermocouple was manufactured at a factory in Tula by the lab of Academician A.G. Shipunov. It had to be dropped into a core of the former reactor, and the cable should have been dropped near the wall of the unit, so that one could jump out of the building and drag the cable into a more or less safe zone. Behind the wall the

radiation level was about one hundred roentgen per hour. I suspected that the cable would drop somewhere in a wrong spot, and the task was not easy. The helicopter pilots, too, were exposed to radiation. Fortunately it did not happen. We were on the second floor, and through the hall we came to the end of the building and behind the window we saw the cable hanging from the roof. It was an incredible stroke of luck. We must thank Pismenny, for he, without hesitation, knocked the window out with his foot (the radiation behind the window was 100 roentgens per hour), and we took the cable and dragged it into the room. Sinelnikov filmed all this, and showed it in his remarkable documentary "The Bell of Chernobyl". The authenticity of the movie is confirmed by photo flashes, captured on film.

In fact, this was our main job, to make sense out of the chaos of radioactive dust, building structures, solidified radioactive lava, to understand where and in what condition the reactor fuel was, whether it could gather into a critical mass (as occurred in natural conditions in Africa), and what was thrown from the reactor into the atmosphere. It was an odd combination of volcanology and nuclear physics. The usual scientific or industrial hierarchy did not exist, as M.M. Zoshchenko said "There are no tenors now! Let him sing with one hand, and work with the other." I still remember the unforgettable feeling of brotherhood on the front lines.

We lived not in Chernobyl itself, but stayed about halfway to Kiev, in a country club. On the wall remained an advertisement from before the disaster of a movie "Servants of the devil on the devil's mill". On the roof there was a stork nest, which was somewhat reassuring. We

would rise early in the morning, come back late at night, and take a shower. We were fed superbly, and the composition of drinking was determined by the taste of our chairman, so that there was some diversity, not just the same legendary cabernet. We were haunted soundly: by the Moscow authorities, by the press, by heat outside and by cold air conditioning in the headquarters. Our indispensable facemasks were getting wet quickly. In addition, we were terrorized by "hot" particles. Indeed, such a particle could land on paper or on clothing, and you catch it like a flea. I cannot say what role the radiation played in our well-being. There were many different speculations. In fact, clearly something happened to our vocal cords. The magnificent bass of L.D. Ryabev turned into a falsetto. We were coughing. Upon my arrival to Moscow, my wife managed to put me in the Kremlin hospital for pneumonia, and there the doctors were trying to get the history of my medical condition from me, but then gave up. In general, more than 1000 men of the Institute passed through Chernobyl and in aggregate our health indicators and mortality rates were better than the Russian average. Of course, this was not due to the beneficial effect of radiation, there were other obvious positive factors. But I think we all do not accept the unbridled radiation phobia swelling in society. After coming back, I have been to Chernobyl a few times since I returned to other matters. The Institute, however, continues to bear their fearless watch. They carried out titanic work, which is described in the relevant literature.

I came home from Chernobyl without any prior warning, and my wife was already desperate and suspected the worst. I had brought with me a large basket of

strawberries. She said "You're crazy!" Fortunately, our great friend from Japan, Professor Husimi, had given us a very good Geiger counter. We measured the strawberries, and it gave a little ring. "Well, now," I said, "measure me." She measured, and there was continuous ringing! I asked her, "Are you going to sleep with me?" She responded, "Well, what else can I do?" "Then," I said, "let's eat the strawberries." So we ate them. Nearly a quarter of century has passed since. All this time the Kurchatov Institute continues to work on the Chernobyl power plant. Our goal is safe final burial of the destroyed unit and the gradual recovery of the territory, the preservation and analysis of the sad experience of overcoming the catastrophe, which was bought at a very high price. Many people from the Kurchatov Institute have tied their lives to Chernobyl. Above all is A.A. Borovoi. His truly heroic work is described in his book to which I refer the reader. I continued to be associated with Chernobyl, but now only periodically, after I returned to my other duties.

Quite unexpectedly, Natalia pulled me into very different activities; into work with children. For her, it was also unexpected, although, as is usual in life, the preconditions existed for both of us. She inherited this talent from her grandmother Varvara Vasilevna Bibikova-Arsenieva, about whom I already wrote, and I had it from my work in school clubs and from the Council of Young Scientists of the Central Committee of Komsomol, as I described separately. In addition, I had an inner need to

give to our children the experience of free international communication, which was formed in my work in science; I wanted to open for them the world behind the Iron Curtain, especially because the era of Mikhail Gorbachev had already begun.

Everything started in a rather prosaic manner. Natalia worked with the Peace Foundation, and there she was offered participation in an exchange program with American students, a sort of "Young Ambassadors of Peace". It was a joint summer camp. Natalia asked me what I thought about it. I said this was a good thing, but asked that I not be enticed into it. I was busy over my head. Our agreement lasted for two weeks, and then she pleaded "SOS! Nothing works!" At that time I was creating an Institute of Program Systems in Pereslavl, and suggested to search there for a place for the camp, asking the Director of the Institute Alfred Karlovich Ailamazyan to help. He readily responded, and our epic began. Back then, I dreamed to enlist into this project a hundred thousand Soviet schoolchildren before the end of the century. This desire seemed for many a pure dream.

Today, in one form or another more than eight million girls and boys went through this project. Of course, the fact that in 1986 I organized the International Forum for Mikhail Gorbachev and a Foundation for the Survival and Development of Mankind helped significantly. I will write separately about those. The usual economic concerns began. It turned out that for the project to begin there had to be a decision by the Party Central Committee. Thanks to my close relationship with Mikhail Gorbachev and Alexander Yakovlev, we were able to recruit the Secretary

of the Yaroslavl Region Committee, Fedor Loschenkov, with whom we at this time began the creation of the Yaroslavl Center for Informatics. I actively was helped by the Foundation director Rustem Khairov and by Gennady Alferenko from Komsomolskaya Pravda. I pulled into the project my new but already very close friend, Mitropolit Pitirim, and through him the Seminary of the Trinity-Sergiev Monastery. Up to this time any communication between the school students and the seminarians had been prohibited, so we made a breakthrough. I remember a strict Soviet party woman, the Secretary of Pereslavl District Committee on Ideology, who was tasked to oversee our event. She learned about our plans and stated that she would permit "this priest" only over her dead body. There was no slaughter, but now, when former Communists are crowding into churches with candles in their hands, it sounds funny.

In addition to ideological problems there were serious economic concerns. After unsuccessful attempts to stay at the kids camp in town, from where we were kicked out by medical authorities, we made a deal with the camp of the local peat factory. It was an ordinary summer camp, which later became nationally and internationally famous and thrives to this day. Back then the camp was in an impossible state of neglect. My wife and I were wondering how well-off people could keep their children in such dreadful conditions. But there was no time to wonder. I used the radio phone in my Chaika limo to arrange an emergency supply of electrical equipment, tableware, sanitary ware, and plumbing, including toilets that were particularly problematic back then. We started with my

wife and friends to glue wallpaper, to clean the floors and the windows, to scrub the showers and the toilets, and to shovel the garbage.

We decided not to forget about the cultural and historical features of the place, and they were many. Kuhmar, the site of our camp, is located on the other side of the Plescheevo Lake from the city, in a beautiful pine forest. Nearby there is a famous monument from the pagan era, the Blue Stone, overgrown with legends. They say that the Christians were trying to bury the stone, but it persistently kept escaping to the surface. So they built a huge sleigh and drove the stone on the winter road across the lake to put the stone, as was customary, into the foundation of a local church. At the middle of the lake the ice did not hold, the sledge broke through, and the stone sank. A few years later, the stone crawled back to the shore and lays there happily today. Naturally, it became a place of worship. Russian Orthodoxy is closely implicated with paganism, and people believe that if you bite this stone, and it is quite soft, this will help you in love. Now the stone is slowly sinking into the swamp on the shore, and people and cows lick it. I must say that the Americans who came to the camp were mainly from Hawaii, from Maui, and people there take such rocks and legends very seriously. In recent years, interest in this stone has reawakened, and we found in the lake a number of its brothers. Even a shaman from the Maya, the keeper of the calendar, came to see the stone and was very impressed. So I decided that this place should be noted somehow. Another place that should be noted was Alexander's hill, on which stood the tent of Alexander

Nevsky<sup>199</sup>, and where for several centuries the two neighboring villages came up to fight once a year. Now this tradition has died out, as there are no strong men anymore.

The third historical site was the Gorodische, the site of an ancient city built in the 6th century, and the earth walls that surrounded the site still exist today. The site is high above the lake; places like that were chosen by the ancient Romans for their cities. Inspired by a reformist desire, characteristic of Moscow's mayors, Yuri Dolgoruky<sup>200</sup> moved the city downhill into a swamp, where it is still located in our time. This deed is considered today as the date of the city's establishment. For those three memorable places I prepared signs made of crossed wooden bars of standard length of 6.5 meters, sanded them and charred them with a blowtorch.

We bought provisions and waited for the guests. The Americans arrived, adults and children. Our children were all from the families of our own friends, because officially it was impossible to form a camp and sign up children in such a short time. Misha Lazarev came as the camp doctor, and since then we were good friends and collaborators with him. The Pokrovsky folklore ensemble choir arrived. Personal computers were brought in, and staff was hired. The camp still exists there, in this original form. Recently one of the original U.S. participants, a Mormon from Seattle, revisited the camp, found and recognized his room, his son's bed and his own bed.

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<sup>199</sup> Alexander Nevsky (1220 – 1263), proclaimed "Saint" of the Russian Orthodox Church, was the Prince of Novgorod and Grand Prince of Vladimir during some of the most trying times in Russia's history.

<sup>200</sup> Prince Yuri Dolgorukiy (1099 – 1157) was the founder of Moscow. He established the town of Pereslavl-Zalesski in 1152.



During the month of the camp's existence there were many events, and one day was one of the most memorable days in my life. Kids and adults, Russians and Americans, pagans, Mormons, and Orthodox in the early morning went on a march to Pereslavl. The march started from the Blue Stone. The morning was foggy, and the sun was hidden by the clouds. Near the stone our choir sang a song to Perun<sup>201</sup>. And then, believe it or not, there came the sun. Together we erected the sign I made and nailed the plate. We repeated the ritual on the Alexander's hill and on the settlement. From there, around Nikita Monastery, which was then in very poor condition, and around the unfinished water pumping station that had been built on the lake, we were cheerfully greeted by the convict-builders on its roof, and we joyfully went to the central square. In the church, the most ancient in Russia on this side of the Dnepr River, the Pitirim's Choir of the Trinity-Sergiev Monastery began singing hymns. The walls of the church for nearly a century have not heard such singing. It was a true miracle and a revelation. From there we went to the Temple of the Danilov Monastery, where restoration had just begun. The restoration, incidentally, is not finished yet. Each temple resonated differently. We went to Goritskii monastery, which now houses a museum. At the entrance stands a T-34 tank. The creator of this tank, Mikhail Ilyich Koshkin (1898 - 1940) was born in the village Brynchagi, in Uglich district, Yaroslavl province (not far from Pereslavl).

We returned to the camp at Kuhmar. Together with Pitirim we played with a Frisbee, which was then a novelty. Then he tied his beard into a knot, and together we ran into

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<sup>201</sup> Perun in Slavic mythology is the highest god of the pantheon and the god of thunder and lightning.

the lake to swim. Later some bastard stole our signs for lumber; I never did have a chance to find the scoundrel. But that was later, and nothing had spoiled that perfect holiday.

Life in the camp was full of adventures and events. On the first day in the rooms for adults the wallpaper fell off. Somebody opened the window too soon. While the new ones were pasted, I took our Hawaiian guests to my friend in the village Usolie on the riverbank. The bathhouse was prepared. One female artist left to for a small need, and went deep into the high grass. The grass turned out to be stinging nettles. There was a piercing scream. It was not just that she burned part of her buttocks, but that on Maui a similar grass can be life threatening. While her friend, another artist, poured buckets of water on her inflamed body part, we tried to comfort her as well as we could. Everything turned out just fine.

In the camp the artists painted, and decorated the walls along with the kids. People danced, played soccer and volleyball, practiced acrobatics, ballet and choral singing. Once, at a turn in a forest road, we flipped over in my Niva<sup>202</sup>, but thank God, with almost no injuries. Near the camp lived a wild forester, all overgrown with hair like Pan. He stoked the sauna on the shore of a small pond, steamed himself and bathed in the moonlight. For some reason his house had no electricity. Everybody really liked this exotic life, and when we, in turn, came to Maui, we got into a very similar environment.

The camp marked the beginning of a long history of school exchanges, many joint camps, including the famous computer camp at Kuhmar, which thrives to this day. Many

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<sup>202</sup> Niva or VAZ-2121 is the Russian compact off-road vehicle built by Lada.

Soviet and American organizations participated in the program, like "People to People" that had existed since the days of Eisenhower, "Children - the creators of the Twenty-first Century", "Sputnik" and several others. The children were greeted in the Kremlin by Raisa Gorbacheva, and at our embassy in Washington by Mikhail Gorbachev. During one of these receptions, an American boy asked Gorbachev why he was not consulting with the children when negotiating anything with Ronald Reagan. "All of you will agree on something, and then we will have to sort it out." Reagan also invited the children to the White House. By the end of the Soviet Union the economic model of student exchanges ceased to operate; the exchanges themselves were not massive, and only affordable to children from wealthy families, so their initial attraction to us has been lost. However two major joint programs were eventually formed.

First, there's Junior Achievement, a non-governmental educational program that teaches the basics of free enterprise. It has existed in the U.S. for over 100 years and is supported by private businesses. My businessmen friends connected me with Jim Hayes, the president of the organization, and the publisher of Fortune magazine. In the sunset of *perestroika* we brought the representatives of the organization into the Soviet Union, they met with Mikhail Gorbachev and Boris Yeltsin, and agreed on cooperation and assistance. And I must pay tribute to the Americans who helped us to create the Russian organization and put it on its feet. They trained us, provided literature, helped with translation and with the creation of the Board of Directors chosen from the heads of subsidiaries of American firms

operating in Russia, and persuaded them to spend their time and money for purely altruistic reasons, despite that they were already fully engaged in their own difficult business in Russia. Such companies as Arthur Andersen, Exxon and Boeing provided excellent chairing for the Council. IBM, Hewlett Packard and many others assisted in organizing events, exhibitions and competitions. Without exception, all the U.S. ambassadors, as well as their spouses, strongly supported the program through their direct participation. My friends in Congress and around the U.S. helped to edit the "Freedom Act". All presidents remember Junior Achievement in their youth and have always supported us during their visits to Russia. The project seriously deteriorated when Western managers were replaced by Russian ones, who had no relevant culture, experience or education. For these managers, as for our businessmen, support for education is only PR, and not the basic social responsibility of the business. Only the "Support of Russia" and The Chamber of Commerce of the Russian Federation are really involved in the program to the best of their abilities. On the other hand, the Russian Union of Industrialists and Entrepreneurs, which I created together with Arkady Volsky from the very initial stage, only fed the program with promises and finally completely declined their support, as did many oligarchs and large firms. With regard to the state, we never counted on its support, and just asked the professors not to steal intellectual property from the organization, and asked government officials not to create obstacles.

What have we accomplished over 20 years of the organization's existence? Entrepreneurship, by the

European Union's definition, is a basic competence required for free and responsible citizens. It is necessary both for the self-employed and for an employee in any sphere of human activity, and is the basis of personal competitiveness and therefore prosperity. It is needed for both personal prosperity and that of the family, the society and the country. In the Soviet school, entrepreneurship was considered at best a hindrance to teachers and educators, and at worst as a crime. We cannot say that there was no enterprise in society; of course it existed, since it is inherent in all creative people, not just in thieves. But on the whole, our generation has suffered from an entrepreneurship shortage and underdevelopment, especially the teaching corps. Thus, it was impossible to rely on training in the classical form for the transfer of the life experiences of our generation to the next, because our experience, to put it mildly, was not very adequate. So I thought, and I keep thinking, that the development of this international program is very important to the former Soviet countries. We launched it in all the republics, and many have shown impressive results.

After its successful launch in the Soviet Union the Junior Achievement program became international, and today is carried out in almost a hundred countries around the world. In the territory of Russia, the program operates in more than 10,000 schools. The education and the books are free. Nearly one million students a year from classes 1 to 11 are trained under this program. At first it is just studying and playing, but in the last three classes of school the kids themselves organize the school companies. In Kazan, Nikolai Nikiforov, a graduate of the program (he is

included in the President's Federal Reserve)<sup>203</sup> created a working model of an electronic government, while the actual federal government is still working on this same problem with little success. On the scale of our organization we are the second in the world after the United States. As a member of the International Board of Directors, during times of crisis, I take the role of chairman of the Council in Russia. It is obvious that for our country 10,000 schools is a small number. We must grow at least by an order of magnitude, and then many of the problems with Russia's economy and democracy might be resolved. I handed over our textbooks on applied economics years ago to Gaidar's government, but as they say, "the horse did not benefit from the fodder". Globally, the most successful company inspired by the Junior Achievement program was the one created by an Argentine kid during its economy crisis. Three years later he sold it for 750 million dollars in cash! Not bad, eh? Vladimir Putin during the Year of Youth directed the Government to support the creation of school companies in Russia. We'll see what will come out of this.

The second surviving program, the Association of Young Leaders, is more complicated. This program was brought from California by my wife and was adapted to our conditions. This is a youth non-governmental self-governing organization, based on the example of Komsomol in its pro-democratic side, without ideology, bureaucracy and supervising by the party. The program teaches responsible citizenship and how to work collectively. The older members teach the younger; thus

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<sup>203</sup> President's Federal Reserve is also called Federal Pool of High Potential Managers.

initiating a "production line", a self-sustaining chain reaction. In our time, this principle may become a new base of lifelong education. Adults are almost absent in this organization.

In the fall of 1986, Mr Gorbachev declared a moratorium on nuclear testing. In the U.S. press this fact persistently was hushed until we announced it in a paid article. We had an idea to assemble an international public forum and explain the objectives of the new policy. For the first time, the Russian emigrants had been invited to the forum. Mikhail Gorbachev decided to finally return Sakharov to Moscow. The podium on this forum has been given to, among other leading public figures, U.S. scientist Frank von Hippel, the President of the Association of American Scientists. At that time I collaborated extensively with Jerome Wiesner, the President of MIT and former science adviser to President Kennedy. Together with Wiesner we had an idea to create the International Foundation for the Survival and Development of Mankind in order to coordinate efforts to control and reduce nuclear weapons. I discussed this idea with Mikhail Gorbachev, and he supported it. Wiesner found broad support from the U.S. public. During the forum, we announced the creation of the Foundation and met with Mikhail Gorbachev. The Foundation Board included Father Hesburgh, the President of the Jesuit University of Notre Dame in the United States, John Sculley, (then-president of Apple), Robert McNamara, former Defense Minister under John Kennedy,

Susan Eisenhower, Frank von Hippel, Andrei Sakharov, the Mitropolit Pitirim, Roald Sagdeev, David McTaggart, CEO of Greenpeace, the president of the Academy of Sciences of China and others. At the meeting in the Kremlin, Mikhail Gorbachev for the first time saw Andrei Sakharov, and I ran into an unexpected problem. Sakharov protested against inviting Jeremy Stone, saying that he was "too left". Jeremy was the director of the Association of American Scientists, which included more than forty Nobel laureates. The Association published the Journal of Atomic Scientists with the famous clock showing the time to nuclear disaster on its cover. This was the most prominent American organization working for nuclear disarmament. Jeremy was very actively helping us in the fight against the star wars initiative and fought heroically for the liberation of Andrei Sakharov himself, so he was at one time even banned from entering the U.S.S.R. D. McTaggart, as a member of the Foundation Board, also did not provoke a great delight in Sakharov.

This issue was discussed in the most categorical terms, and somewhat determined all of Sakharov's subsequent relations with the Foundation. There was a lively conversation with Mikhail Gorbachev, and it began with the issue of those dissidents who were still imprisoned in the U.S.S.R., and then the discussion switched to nuclear disarmament. The limit proposed by McNamara, 400 warheads on each side, sufficient for deterrence, was widely discussed. Gorbachev asked the opinion of Wiesner, a living witness to the Cuban missile crisis. "For Kennedy, one warhead for New York was enough" said Wiesner. Many issues were discussed, including environmental ones.



We agreed that the Council would meet on the condition of admission of all of its members to the host country. It was necessary for Professor M. Sela of Israel to attend the meetings, since Israel had no diplomatic relations with the U.S.S.R. In the future, this condition helped me to gain permission for Sakharov's first travels abroad, to America. Thus began the work of the International Foundation. We invited Rustem Khairov to work as the Executive Director of the Soviet side, and to this day he still bears this difficult burden.

At this time, I regularly accompanied Mikhail Gorbachev to his meetings with the Presidents of the United States, first with Ronald Reagan, then George Bush. The next meeting was held in Reykjavik. Mikhail Gorbachev envisioned that this meeting had to radically change the course of stalled talks on missiles in Europe and on strategic nuclear forces. The stumbling blocks were the strategic nuclear initiative and the deployment of weapons in outer space. Our negotiators and military experts were convinced that by 1990 the Americans would deploy space weaponry. The Americans treated me seriously: during my trips to Washington I was not allowed to leave the city, either for work or on private invitations. They published some nonsense about me in Moon's *Washington Times* and in official brochures; they claimed that even though I was speaking in public against the Strategic Defense Initiative, in fact, I was actively working "under the carpet." Our crazy secrecy helped to maintain these myths. It is for this reason that I began to promote a policy of military

transparency, because I thought that it was necessary to destroy the diabolic alliance of American militarism and Soviet super secrecy as the main engine of the arms race.

By the time Mikhail Gorbachev came to power, a few issues had accumulated which complicated our relations with the West:

1. The accumulation of strategic nuclear weapons, disproportionate to any conceivable military or political objectives. This had already been understood by society, and by political and military elites. Attempts to achieve a temporary advantage through technological "breakthroughs", like developing separating maneuverable independently controlled warheads, low-flying cruise missiles, protected missile shafts, mobile bases, and all the more exotic types of radiation or beam weapons, were leading only to accelerating the arms race and to increasing useless expenditures. Therefore, strategic arms limitation and prohibition of weapons of mass destruction was a deliberate objective of our politics, but it was an extremely difficult goal from the point of view of international and domestic political conflicts, and from the short-term goals and interests of politicians. However, already by 1986, the feasibility of a fifty percent reduction was outlined (SALT-II, START)<sup>204</sup>.

2. Intercontinental ballistic missiles and nuclear weapons have made the U.S. vulnerable, and this feeling is deeply lodged in the American public consciousness. Therefore, the strategic missile defense, including space forces (Star Wars), together with the idea of eliminating nuclear weapons, or at least eliminating ballistic missiles,

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<sup>204</sup> SALT, Strategic Arms Limitation Treaty; START, Strategic Arms Reduction Treaty.

was and remains popular in America. Good intentions paved the road to hell, and the success of the populism of Ronald Reagan, the Great Communicator, greatly complicated the situation with the negotiations. Even such an educated and skilled politician as Henry Kissinger asked me during a meeting in Atlanta for Jimmy Carter, "How can the Soviet statement on the technical insolvency of the missile defense be combined with the Soviet request to limit this missile defense?" I am a slow thinker, so Dick Garwin from IBM, a designer of the first American hydrogen bomb, quickly responded to that. "Go to a toy store and buy a plastic gun. You know that it is a toy, but try to point it to the head of an armed guard on duty and see how it will end." Dialectic thinking never crossed the English Channel. This problem did not allow for a possible breakthrough in the negotiations between Gorbachev and Reagan, and still remains a stumbling block.

3. The third problem was the medium-range missiles in Europe, the famous "Pioneers" (SS-20). It was the pride of Ustinov, indeed, a remarkable machine by a very talented designer A.D. Nadiradze. I have used in my MHD generators a slightly reworked first stage of this rocket; it gave a gas flow rate of 1 ton per second, and developed a thrust of 500 tons, far more than many of today's space rockets. We teased the bear, the U.S. and Europe, without a solid reason, and then for a long time tormented the negotiations. In the end, Reagan and Gorbachev concluded these negotiations, though just barely, and with great fanfare.

4. The fourth problem was the idea of the overwhelming superiority of the Warsaw Pact in

conventional weapons. There were, of course, people of insight who strongly doubted the reality of this superiority, but it was the general belief (or delusion), which, thank God, no one tested in real life.

The negotiations dragged on without result. Mikhail Gorbachev tried to turn the tide in Geneva in November 1985 but without much success, except for an agreement on the International Experimental Thermonuclear Reactor, which I have already described, but this was a smaller issue. The second time Gorbachev tried to do it in Reykjavik with new non-standard suggestions, the so-called "new thinking". Indeed, he prepared a number of surprises for the American hawks, to the Secretary of Defense Caspar Weinberger and to the "gray cardinal" Richard Perle, but as usual he did not go far enough.

Reykjavik is the capital of Iceland, part of the Arctic. "We are the people of the North, and the beds of our rivers are taking calm, unhurried beginnings" (Yu Martsinkyavichus). Norwegians, Swedes, Finns, Russians, Americans from Alaska, the Canadians, these people are calm, peaceful in recent times, and it's not bad. We, I think, can get along much better together than the rest of troubled humanity. In those days I made friends with O. R. Grimsson (now President of Iceland).

We lived on a ship, and there we discussed with Gorbachev a course of negotiations. During Gorbachev's presidency his aides assembled a small group of support that, I think, quite effectively helped him during the negotiations and in so-called information warfare, though certainly it is not for me to judge, as I am an involved person. Certain days and nights remain in my memory,

markedly the day when our bosses seemed to have agreed on everything and asked us to finalize the details. Our team was led by Marshal Sergei F. Akhromeyev, and their team by Paul Nitze. Together with the deputy department head of Foreign Ministry G. Kornienko, Akhromeyev perfectly mastered the material and felt confident. Paul Nitze was also a veteran in the matters of armament, so it's no wonder his memoirs were called "From Hiroshima to Glasnost." He was a very knowledgeable and independent politician under all the bosses, but despite a close relationship with Ronald Reagan, he was not feeling very confident.

Across from me sat Richard Perle, the Deputy Secretary of Defense, who continually scribbled something on little pieces of paper and was passing them to Paul. He read them, puffed and made corrections. We took a break, reported to our bosses on our thoughts and received further instructions. But the matters were not progressed enough, and by morning, when our energy was exhausted, we all went to sleep.

Before going to sleep, I still managed to give an interview to journalists from the BBC, with whom I had made previous arrangements. I had just dozed off when a phone rang. It was Gorbachev's spokesman. "What have you done? You ruined the talks! Reagan's press secretary has already ran to report on your interview! We had an agreement: the one who knows something is silent, and the one who says anything - knows nothing!" "Well, but I do not know anything, so why are you so nervous?" I replied and went to bed. What was done, was done. Well, I had Sredmash experience, so I can keep secrets, and I never said anything excessive in my entire life, so I was calm. I

had just closed my eyes, and there was a knock at the door. I opened the door, and I saw television cameras and microphones. "What did you say, what leak did you give?" "Nothing," I said. "I said nothing, and I gave no leaks!" I slammed the door and went to bed hoping for a little sleep.

I woke up before the dinner, and my colleagues said "Well, Arbatov is very upset!" "Why?" I asked. "Because he was not the first who gave the leak..." was the answer. Over dinner, Gorbachev reaffirmed the lack of linkage between the negotiations on medium-range missiles and the SDI (Strategic Defense Initiative). Just what I had told to the BBC reporters, but in the flurry no one paid attention to my words. Unfortunately, later someone persuaded Mikhail Gorbachev to change his mind about the lack of linkage, which resulted in a delay in concluding a treaty on medium-range missiles for as much as six months. As a result the negotiations on strategic arms were held at the time when Ronald Reagan got involved in the Iran-Contra affair and could no longer effectively manage the process, especially in Congress. Therefore, for a long time the treaty on strategic arms remained unsigned, which had a bad influence on our relations with the United States.

When the agreement on medium range missiles was finalized, I went with Mikhail Gorbachev to a summit in Washington, where the signing was scheduled. The procedure was majestic, but I was late for the reception. I ran through the White House basement, when a hefty security guard who met me said "Do not hurry, Mr. Van Cliburn, they will not start without you." I replied, "Unfortunately, they will start, since I am not Van Cliburn, and I have no musical talent whatsoever." Thank God, I

made it on time. I entered the room, when everybody was singing "The Moscow Nights", and I realized that I was not the only one without musical talent... Reagan made his famous statement, "Trust, but verify." After the concert the dancing began, and I found myself without a partner. Congressman T. Stevens of Alaska introduced me to his wife and said "Dance with my wife, that's our tradition." Madame Stevens was a charming lady, and I enjoyed dancing very much. Well, I do not know if she experienced the same enjoyment: I am not Van Cliburn, and I am also not Petipa.

I became acquainted with W. Hickel, the predecessor of T. Stevens, the former governor of Alaska and the Interior Minister in the government of Richard Nixon. He was a legendary man who came to Alaska with 50 dollars in his pocket and turned the former U.S. colony into a prosperous state with remarkable achievements in the social field. He ensured the development of the civil society and the prosperity of local people, he organized the Institute of the North and cooperation with the Nordic peoples of Russia. After creating the Civic Chamber of the Russian Federation, I repeatedly invited him to meetings of the Chamber to give him an opportunity to tell the story of Alaska's economic and social development of Alaska as a lesson for Russia. I do not know if the Russians will learn from this lesson.

The Governor W. Hickel invited me to Alaska to ski in Anchorage. The ski resort near Anchorage is excellent, but the snow is very wet and the fog is thick. A warm moist

air comes from the south Pacific and gets stuck in the mountains. My wife and I stayed in a wonderful Japanese hotel, "The Prince". A lift out of the hotel entrance goes straight up the slope. I rented a car and asked my new friend, "Is there any theft here?" "Not at all," he said, "no one would even think about it, you cannot run away from here." I believed him, so I parked my car near the hotel not very neatly, and went to sleep. In the morning I decided to re-park, and very timely so, as there was a tow truck there already. I asked the hotel manager, "Why are they so quick here?" he replied "Because we inform them; it's extra income for us!"

On the mountain there were competitions for people with disabilities. The Kennedy family and Arnold Schwarzenegger were among the spectators. Schwarzenegger in real life has quite an unusual look, and he does not look as tall as in the movies. He drove a Hummer H-1. I spotted it, and eventually I bought a used one in America, the same model, for my village driving.

I was invited to fly to the very north of Alaska to Barrow, and from there to a former military base, now a well-equipped laboratory of a research institute. It was windy and cold there. Just in case, all the locals tied sledges to the upper racks of their specially equipped cars. The local mayor also had a silver Hummer-1. "Is it good?" I asked. "It is good," he said, "it just can't be driven here. It's too cold for this car, and the snow is usually too deep for it." The town had a good school, a boarding school and a library. On its outskirts, near the landfill, you can see polar bears, which come there to eat. The Japanese tourists like



taking pictures of them. People said that one tourist was eaten by a bear.

I continued my civic activities related to negotiations on arms limitation. Our Foundation, in the course of developing the idea of military transparency, organized a trip for a group of U.S. congressmen and community leaders to the so-called "critical points of our disagreement." The group was led by Tom Downey and included, among others, Frank von Hippel (President of the Federation of American Scientists), Thomas Cochran (Natural Resources Defense Council), and Anthony Battista (House Armed Services Committee staffer). We discussed the many joint initiatives on arms control, in particular, a unique arrangement between the Democratic Congress and the U.S.S.R., the Soviet moratorium on placing weapons and anti-satellite systems in space, and the counter decision of Congress not to fund such activity in the U.S. This informal agreement continues to work up to now, although repeated attempts to legalize it by the Soviet side were not successful, not at that time, and not now. Bill Clinton was also part of this group. When he arrived in Moscow, already as the President, and Tom Pickering introduced him at the Spaso House<sup>205</sup>, Bill saw one familiar face, mine, and joyfully exclaimed "Eugene, do you remember me?" Of course, I pretended to remember, however, I generally

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<sup>205</sup> *Spaso House* is the residence of American ambassadors in Moscow since the establishment of diplomatic relations with the United States. Tom Pickering was U.S. Ambassador to Russia during Bill Clinton's presidency.

remember new faces poorly, and he apparently had not been very active in the group of T. Downey.

Our journey began with a visit to the missile warship “Slava<sup>206</sup>” of the Black Sea Fleet. There we set out on a unique experiment with our American colleagues: the taking of an isotopic "fingerprint" of a real nuclear warhead. The need for such a demonstration was associated with a problem that impeded a possible treaty on limiting the deployment of nuclear weapons carried by military vessels. The U.S. military had categorically been against, and continues to be against, a physical inspection, so we were looking for other technical means for verification. There were venturers among us, such as Academician V.L. Barsukov, who on this topic had a serious disagreement with R.Z. Sagdeev. Our experiment was done correctly, but, unfortunately, neither the U.S. nor our military agreed to subsequent continuation of this cooperation. On this occasion, we met with Jack Matlock, when he was the Ambassador, and with Paul Nitze in Washington. In his very thorough book, he remembers how I visited him at the Embassy. I do not remember all of the Embassy staff, but memory kept an image of the two gloomy gentlemen who sat next to P. Nitze and were silent the entire time. Paul himself was the only one asking questions. This problem still remains, and will become a serious stumbling block, when (and if) a real discussion about the reduction and elimination of nuclear weapons will start.

I made an arrangement with Mikhail Gorbachev to invite the group to visit the Krasnoyarsk radar. In connection with the placement of the radar in that area, the

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<sup>206</sup> *Slava* means Glory in Russian.

American hawks, and not only the hawks, accused us of violating the letter of the Treaty on the limitation of missile defense, the observance of which we always abided by so pathetically. In fact, it was indeed a flagrant violation, and our military-industrial complex was directly to blame for it. The reason for placing the radar in Krasnoyarsk was due to the fact that there already was some kind of operational infrastructure there, and on the border, in the Far East, there was no infrastructure whatsoever. It was clear beforehand that the scandal would break. Nevertheless, the decision was made. "Let them slander!" At this time in America debates were held on the so-called "broad interpretation" of the ABM Treaty. This was directly related to the issue of the SDI, the right to develop, test and deploy missile defense systems, including those based on new physical principles. Realists, including P. Nitze, rightly believed that nothing would come out of this in the foreseeable future, and while they were supported by almost the entire scientific community, they were in a different political camp. In the government camp there was a group sticking to the original interpretation of the treaty, and opportunists who proposed a new, broader interpretation, opening the way for SDI. In the end, the first group won, and under G.W. Bush, Jr. the U.S. simply got out of the treaty.

Under Reagan the second trend prevailed. The lawyers were hired, in particular Soifer, and they began to argue that the treaty actually forbade nothing. This is a very interesting feature of American life, the full recognition of the primacy of law and hyperactivity in finding loopholes. We have, incidentally, a proverb on the topic: "The law is like a light post, you cannot jump over it, but you can

always get around it." T. Downey wrote to me. "Eugene, we have started to employ lawyers in our laboratories instead of experimental mice. The mice usually generate sympathy, but the lawyers don't." This again is consonant with our joke: "What is the difference between a lawyer and a sperm cell? No difference. Both have a chance to become a man: one in a million." In this case, the society itself is raising them this way. In general, the Krasnoyarsk radar situation gave an excellent example for the opponents of the treaty to accuse the Soviet Union of mendacity.

We wanted to demonstrate and convince the Americans that the radar did not violate the spirit of the treaty, since the radar had no backup power which would have withstood the beginning of the war, and its structures were not adapted to military use. The Americans confirmed this conclusion, including it in their report. It seemed that the way to a reasonable compromise opened. But the ambitious E.A. Shevardnadze listened to nobody, and went on with a new lie; he said that the radar was built for tracking space objects. There is no need for a university education to understand that this is nonsense. And the President of the Academy G.I. Marchuk eagerly supported this lie and began to propagate it. During the next step of negotiations, Shevardnadze agreed to the destruction of the radar. As a result, we suffered serious material losses, and in our early warning system for nuclear attacks a huge gap formed in the most dangerous direction, from the Asia-Pacific. This gap is still not closed today. This is another fundamental question: Is the whole strategy of the

inevitable backlash just another "Potemkin village"<sup>207</sup>, to which both sides, the Russians and the Americans, continue to spend crazy money?

The visit to the super-secret factory "Mayak" by the Americans was associated with a demonstration of our real steps to reduce the production of nuclear materials and to enhance the safety of the nuclear industry since Chernobyl. We announced the closure of our first commercial reactor that produced plutonium, the so-called "Annushka", and invited the group to see it. For them, the invitation was a complete surprise, since we did not have any obligation or even requests from them. They were the first Americans who came to see the super-secret plant that produced plutonium for the destruction of all Americans (and not just of Americans). The local residents and the management of the plant greeted them with such joy and hospitality, as if they were waiting for this for their entire lives. The director, the man of the old school, showed "Annushka" and all its systems.

Then we went to the lake, of course not to the lake where the waste was poured, but to the adjacent one. We swam and ate the crawfish that were caught by locals, among the magnificent nature of the Ural Mountains. It was hard to believe that this was the same Kyshtym where a barrel of radioactive waste exploded in the 50's<sup>208</sup>. Even in more recent times, the Soviet Union officially denied the

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<sup>207</sup> *Potemkin villages* is an idiom based on a historical myth. According to the myth, there were fake settlements purportedly erected at the direction of Russian minister Grigory Potemkin to fool Empress Catherine II during her visit to Crimea in 1787.

<sup>208</sup> The Kyshtym disaster was a radiation contamination incident that occurred on 29 September 1957 at Mayak, a nuclear fuel reprocessing plant in Russia (then a part of the Soviet Union). It measured as a Level 6 disaster on the International Nuclear Event Scale, making it the third most serious nuclear accident ever recorded (after the Chernobyl disaster, and the Fukushima I nuclear accidents, both Level 7 on the INES scale).

fact of this "first Chernobyl". I tried to break through the consent of silence, but L.D. Ryabev, then the Minister of Medium Machine Building, objected because he feared that he would bear all the costs of rehabilitation.

The Americans, of course, knew everything, but were not particularly noisy because of "selfish" interests. In England, Zhores Medvedev was vocal; he knew something in connection with his work in the U.S.S.R., but he did not know all, so he fantasized quite a bit. We did not object to his statements, as we denied the very fact. In addition, it was difficult to take advantage of the huge material, which had been accumulated by the expedition led by the great Bison, Academician N.V. Timofeev-Ressovsky, who was working there in imprisonment. And to us this was very essential, in view of the aftermath of Chernobyl, to not start from scratch.

I then tried to do everything by the rules, but finally gave up, and in Japan I openly admitted this fact personally and, indirectly, on behalf of the Academy of Sciences. Academician I.A. Sokolov, who dealt with these issues professionally, was able to process and publish valuable materials. It would be much better if we had done it all before Chernobyl. We would be able to discuss these events with the Americans from the perspective of damages to people, nature, and rehabilitation measures.

The next stop was Sara-Shagan, the top secret test range at Lake Balkhash, where we tested components of our missile defense systems. In the U.S., General George Keegan led at that time a vigorous campaign in the press and in Congress, trying to prove the falsity of our policy with regard to criticism of SDI. He demonstrated different

satellite images, and argued that at this site we deployed laser weapons that could shoot down U.S. warheads, missiles and satellites. Program management at the CIA "revealed" me, and at the summit in Geneva, distributed superbly printed pamphlets with fantastic pictures with my portrait. This campaign was actively subsidized by Moon in his newspaper *The Washington Times*. In addition to advocacy, this company pursued quite a material goal, to achieve a multi-billion dollar commitment of appropriations for SDI from a skeptical Congress.

In fact, this was smoke *with* a fire. At the test site a monstrous system of so-called missile defense laser systems had been deployed a while ago. But Y.B. Khariton was a wise man, honest and brave, and sorting through all this "Potemkin village", sent a letter to the Politburo. The program was transferred to the rank of long-goal scientific research projects, but the traces of its former majesty remained on the test site. Those remnants were interpreted by General G. Keegan as the great achievements of the Soviet military-industrial complex. All this we showed and explained to the Americans, and they published a completely honest report.

The measures taken strengthened the credibility of the Soviet Union and advanced the process of peace negotiations. But they were not in any way comparable with the degree of the wild sell-off of Soviet secrets, which began in the troubled times of Boris Yeltsin and A.V. Kozyrev. It led to the situation when now I sometimes get from my American colleagues documents of the Politburo with the heading "Top Secret, special folder, Series K", to which I did not have access in Soviet times. Despite the

active process of transparency, neither I nor the Kurchatov Institute ever had any complaints from the special services.

The activities of the Foundation for the Survival of Mankind were directed by the Board of Directors, and fundraising as a special form of activity was assumed by Jerome Wiesner. Sometimes he included me when I was visiting the U.S. We decided to conduct the second meeting of the Board in the U.S. Getting permission for Sakharov to leave the U.S.S.R. was the main difficulty. On this issue, I pleaded to the authorities. At this time, Vadim Medvedev, the Head of the Department of Science of the Central Committee, was elected to the Politburo. At one reception he made a very important statement. "We have decided to return to Sakharov all his regalia, but not allow him to go abroad." I exploded. I said, "I do not know whether he cares about these regalia", and continued further, using profanity. And then I went to look for Mikhail Gorbachev. Gorbachev created a special commission on this issue. It included V.A. Kryuchkov of the KGB, V.I. Ryabov of Sredmash, Y.B. Khariton, myself, somebody from the Military Industrial Commission and from the Ministry of Foreign Affairs, and G.I. Marchuk from the Academy. The Board almost unanimously proposed to allow Sakharov to travel abroad.

Everything was ready, the Americans were waiting, and the tickets were ordered. I was sitting in a blissful state at the Presidium of the Academy. The phone rang. In the



handset I heard the worried voice of Elena Bonner<sup>209</sup>, "Eugene, we're not going." "You're crazy, what's the matter?" I replied. "They will not let someone from Kovalev's group on Human Rights go." I tried to figure out the situation in the Department of Visas. It turns out that one of the team members just recently returned from a labor camp and had not yet received a passport. I said to the head of the Department, "To hell with the passport, prepare his travel papers based on a temporary ID." Oddly, this worked, and the Americans allowed this person into the country. Those were the days...

We arrived in Washington and saw a cheerful meeting with many cameras. And Andrei Sakharov, right at the start, said that Gorbachev and his perestroika, as well as the Foundation, could not be trusted. Gorbachev lived through this, I lived through this too, but Wiesner, unfortunately, did not. He had invested so much of his personal energy in advertising Sakharov, in organizing this trip and into building the image of the Foundation, his health gave way after this remark, and soon he was gone. The Foundation has done a lot of useful things since then, but after the collapse of the Soviet Union, the Americans have decided that public organizations will be operated in "manual control" mode, from the Department of State, and withdrew from the Foundation. The Foundation continues to exist. It has helped Mikhail Gorbachev to create his own fund and the "Green Cross"; it worked on the document "The Earth Charter" and on a number of programs with UNESCO; it has established relations with many international and

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<sup>209</sup> Elena (Yelena) Bonner (born 1923) is a human rights activist in the former Soviet Union and the wife of Andrei Sakharov.

religious organizations; it arranged the visit of the Dalai Lama to Russia, and our response to visit him in Dares Salaam, etc. Rustem Khairov still remains a Director of the Foundation.

In 1978, my social and political activity went in a new direction. Mikhail Gorbachev brought me to the CPSU Central Committee, first as a candidate, and then as a member of the Central Committee. I began to attend plenary sessions. I did not demonstrate any particular activity, though once I made a proposal to split the Communist Party into two parties. Gorbachev said "On what basis?" I replied that it did not matter. Orthodox communists said that I wanted to destroy the party, and the "Ogonek"<sup>210</sup> wrote that I wanted to save it. So the idea was cursed by the left and by the right. The idea was floating in the air, the reformers had not yet left the party, and it would have been possible to create a second party with a social-democratic bias. Some people are still trying to do this, but not very successfully. No one picked up the idea then, and I did not claim the role of party leader. One time, after the Armenian earthquake, we, together with S.G. Arutyunyan, then the First Secretary of the Central Committee of Armenia, proposed to provide economic independence to Armenia and seek international assistance for modernization of its economy. "Well, you're quite a politician," said Mikhail Gorbachev. Instead N.I. Ryzhkov took charge, mobilized the whole of Russia and went to save Armenia, becoming the hero of the Armenian people.

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<sup>210</sup> Ogonek is a liberal magazine published in Moscow.

So this is how my political activity in the Communist Party ended rather ignominiously. But it had some continuation, since I was included into "The Red Hundred" for the formation of the U.S.S.R. Supreme Council. I was sitting next to a wonderful man, S.V. Veprev, chairman of the committee on agriculture. We fell asleep to the music of disputes between A.A. Sobchak with F.M. Burlatskii, and the next morning the children told me "Dad, are not you ashamed, you were asleep again, and the whole country saw it!" There was a camera in front of us, and the whole country watched with bated breath for the work of the first freely elected parliament and congress.

Gorbachev asked me to head a commission on defense. Since I had worked on defense and negotiations on arms limitation and knew well my colleagues in the U.S., in particular, Les Aspin, the chairman of the U.S. Armed Services Committee, I agreed. However the Secretary of the Central Committee O.D. Baklanov and the head of the Defense Department O.S. Belyakov had other plans and nominated another candidate. Mikhail Gorbachev, as usual, let things drift, and they chose the other fellow. God be their judge, as well as his.

In the Supreme Council, I performed various tasks, for example, I went with A.A. Sobchak and with V.V. Putin to triage the situation in Tajikistan, where the people had come out into the streets, but the local officials were afraid to talk to the people. We resolved the situation. This was when I first met with Muslim clerics and began to understand the problem. I assisted the Inter-Regional

Deputies' Group<sup>211</sup> in the Congress of People's Deputies. I provided them with a work place in the House of Scientists<sup>212</sup> and supplied them with their first computers, which aroused the anger of Mikhail Gorbachev. I recommended Evgeny Primakov to the post of chairman of the Supreme Council, and I watched the fury of democracy, when the laws were passed in stride by simply voting. Finally, when voting in the Congress, I proposed my own candidacy for the President of the Supreme Council, and lost to A.I. Lukyanov. Votes were counted by Y.A. Osipian, and Gorbachev appointed him an adviser on science after that. I, of course, wanted that job not only due to career reasons, but because of several important projects which I was promoting, such as computerization, ITER, and others. Of these, the most important project was the creation of the Third Global Aircraft Company, a competitor to Boeing and Airbus. There was a remarkable group of entrepreneurs supporting this idea, R. Maxwell, A. Hammer, S. Eisenberg, and the soul of group, A. Schwimmer, the creator of Israel's military aviation. We collaborated with the Russian aviation industry, in particular, with G.V. Novozhilov and A.N. Tupolev. Gorbachev received support in America. Osipian, however, took this project away from me. Later A. Hammer died, R. Maxwell drowned under mysterious circumstances, and S. Eisenberg was not able to conduct a work of such magnitude, so the project fell apart.

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<sup>211</sup> The Inter-Regional Deputies' Group (IRDG) took shape in June 1989 as a loose democratic grouping in the first U.S.S.R. Congress of People's Deputies.

<sup>212</sup> The House of Scientists is an elite club of scientists and academicians in Moscow.

The same thing happened with the project to modernize our shipbuilding industry, which was offered by a well-known banker Bruce Rappaport. I arranged for him to meet with Mikhail Gorbachev. During that time there was a shortage of meat in the Soviet Union, and I asked Bruce to bring some canned food for my dogs on his own plane from Geneva. We met in the Kremlin, he put one box in the trunk of my car, and the second box he dragged with him to Mikhail Gorbachev. "What have you got?" I asked. "Swiss watches" he said. I told him "Are you sure that is not dog food?" He broke out in a sweat. He opened the box in the middle of the square, and it turned out to be watches. We met with Gorbachev, who, as usual, began to tell the guest what a great country the Soviet Union was, what were its natural and intellectual resources, and what would be a bright future. He talked, and talked, and he could not finish. Bruce became clearly bored. He asked, "Can I tell you a Jewish joke?" Gorbachev was slightly taken aback, but agreed. So he began: A Jew's wife died. When she was buried, and after everyone left, the rabbi approached the bereaved husband and began to calm him down. "Well, it may take a year or two to stop grieving, but be comforted," the rabbi says. "A year, two years," said the Jew "But what will I do for tonight?"

That's how we were left with our bright future. The Political life of the Central Committee and the Supreme Council was interesting for me, but did not bring much use to anyone.

The epoch of decay began. I have noticed that when things get really bad, the authorities requested my service. Mikhail Gorbachev invited me to the Presidential Council. At this time I was already deeply concerned about the fate of the Academy and of the Kurchatov Institute. Academicians A.A. Gonchar and L.D. Faddeev came to me and shared their fears. We decided that the Academy should be assigned the status of a Russian National organization, since the Academy of the Soviet Union, in essence, was the Academy of Russia, and each republic had its own national Academy<sup>213</sup>. At this time R.I. Hazbulatov, V.A. Koptuyug and G.A. Mesiatz worked to build a new Russian Academy from scratch, hoping that in the new Academy they would play a leading role. Mikhail Gorbachev was against a transfer of the Academy to Russian jurisdiction, G.I. Marchuk had bad relations with Boris Yeltsin, the Presidium of the Academy was divided, and many thought about their own advancements and of the division of Soviet inheritance. Still, we managed to mobilize sufficient support, including the Chief Scientific Secretary Igor Makarov in person. At the general meeting the Academy decided to turn to Boris Yeltsin.

At this time the new (parallel) Russian Academy was hastily preparing for the organizational meeting. Elections had already happened, and Yury Osipov was elected as the President. He held a very constructive attitude towards the Academy of the U.S.S.R., and we agreed to merge the two academies into one, the Russian Academy of Sciences. But

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<sup>213</sup> The U.S.S.R. Academy of Sciences was a federal organization, mostly representing scientists from the Russian Federation. All the Soviet republics, except for the Russian Federation, had their own National Academies.

he was not the only player. If the new Russian Academy managed to organize itself as an independent organization, it would be the end of the great Russian Academy and a "civil war" would start, as had happened with many other cultural institutions after the breakup of the U.S.S.R. I spoke with Boris Yeltsin, and he gave his consent to the new status of the Academy.

It was urgently necessary to sign the decree. I telephoned Boris Yeltsin, someone, probably Korzhakov, picked up the phone and said that today Yeltsin could not do that, because tomorrow he was scheduled to fly to Germany. I asked to see if I could meet with him tomorrow at the airport, and got a positive response.

But the draft decree was held by G.E. Burbulis, who at that time served as an acting Chairman of the Russian government. I arrived at the Old Square, to the government offices, and tried to get to Burbulis. He was busy with some religious folks and other strange people. Finally, he got out but walked into the conference room of the Secretariat. What could I do? I.M. Makarov came to the rescue. "Just go there!" he said firmly, pointing to the door where the meeting was held, and literally pushed me inside. The members of the Government were slightly surprised when I approached Burbulis and asked him to give me the papers. At first he protested, but then he reluctantly initialed the papers and gave them to me. I could not even think about doing this with Kosygin! The next day, at the "Vnukovo" airport, Boris Yeltsin signed the decrees for the transition of the Russian Academy of Sciences and the Kurchatov Institute to be under the jurisdiction of the Russian Federation. The Kurchatov Institute at its birth was directly

subordinate to the Government, to the First Chief Directorate. Then, under Aleksandrov, the Institute came under the management of Sredmash, the 16th Department. By the decree of Boris Yeltsin, we were again reporting directly to the Prime Minister. Viktor Chernomyrdin was surprised to learn about it when a couple of years later he came for the first time to the Institute. Later, we were subordinate to Rosnauka<sup>214</sup>, and now, thanks to M.V. Kovalchuk, the new director of the Kurchatov Institute, by Presidential Decree, we once again are independent.

As always, in late August, a traditional workshop in Erice took place. At this time a surprise was waiting for us: the GKChP, the State Committee of the State of Emergency<sup>215</sup>. I immediately called the embassy, but they gave a rather vague explanation of what was happening. Our main source of information was television. The delegation naturally was split. My wife, my daughter and my youngest son, who were with me in Italy, immediately joined the Democrats. Academician I.M. Khalatnikov, as always, was the “first” to know everything: "Gorbachev was already arrested and shot!" We were joined by our friends, and we sent an appeal to Giulio Andreotti in support of Mikhail Gorbachev.

It was clear for me that I, as a member of the Supreme Council, should return to Moscow. But at the same time, based on historical experience, we believed that nothing good was waiting for us at home, so we had to make a decision about our children. Al Trivelpiece from Oak Ridge

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<sup>214</sup> Rosnauka (abbreviated from Russian Science): Federal Agency for Science and Innovation.

<sup>215</sup> The GKChP (in Russian: abbreviated from Gosudarstvenniy Komitet po Chrezvichaynomu Polozheniyu), the State Committee of the State of Emergency, attempted to take control of the country from Soviet president Mikhail Gorbachev in August of 1991.



immediately responded and instantly issued us an invitation. At this point, the meeting of the Emergency Committee was shown on television, and I realized that this "Komsomol kindergarten" could hardly achieve anything. The well-known history of failure of the Emergency Committee began to unwind. We returned to Moscow. As I've written, in time of catastrophe I am always turned to by the authorities. Mikhail Gorbachev invited me to the Presidential Council, but my main concern was to save the Academy and the Kurchatov Institute.

A new era began, the darkest years of President Boris Yeltsin. Everything around us staggered. The Kurchatov Institute, after obtaining freedom, had lost its funding. I teamed up with Genrich Novozhilov, and we arranged an exhibition for Boris Yeltsin at the Ilyushin Design Bureau. I started focusing on an idea that I previously tried to develop, an exploration of the Arctic shelf in collaboration with the nuclear ship industry. All of this perfectly organized sector—200,000 jobs, unique plants, primarily Sevmash, design bureaus, scientific and technological institutions—all were struggling financially. At the exhibition we demonstrated to Yeltsin the resources of the sea shelf, and the potential of the industry. Everybody was excited with the idea of converting the military-industrial complex, but I suggested diversification that would save the defense contracts and simultaneously create new energy industries. In Russia, quasi-reform activity was rising like yeast. Some experts suggested converting defense plants into small scale manufacturers of, for example, tableware

and kitchen utensils, while others in parallel started active negotiations for the transfer of licenses and know-how to the West. Many rogues of all kinds, especially from America, worked in Moscow at that time.

Boris Yeltsin supported the idea of diversification, and I found powerful allies, D. Pashayev, the Director-General of Sevmash, and R. Vyakhirev, the President of Gazprom. We agreed on the establishment of the company Rosshelf, whose shareholders were Gazprom on one hand, and a nuclear submarine engineering company headed by Sevmash on the other. The company applied for a license to two fields: the Stockman gas condensate field in the Barents Sea (3.2 trillion cubic meters of gas), and the Prirazlomnoye oil field. The idea was to start with the latter, and subsequently develop Stockman using the income received. The same fields were of interest for a consortium that included Norwegian capital. The Ministry of Energy, for obvious reasons, supported the second option. Boris Yeltsin assembled oil and gas industry folk to a meeting at which he announced his appointment of Viktor Chernomyrdin to the post of Energy Minister. I took the opportunity and spoke about our project. Yeltsin supported the project and instructed Chernomyrdin to prepare a decree. At that time the formal procedures were simple. Vyakhirev and I agreed that Rosshelf would get the licenses, and Gazprom would receive 51% of Rosshelf shares. Chernomyrdin initialed the document, and the next day Boris Yeltsin met us and signed the decree.

Of course, this was not the standard model that is taught in U.S. business schools: combining the customer (power company) and the contractor (machine builder) into

one company. But we had to completely modernize Sredmash manufacturing using financing from Gazprom, and Vyakhirev would not approve such financing without some security. And the real property was the only security he could rely upon at that time. E.P. Gaidar and his team were against it, but I must pay tribute to Boris Yeltsin, who realized the crux of the matter, and did not go with them on this issue. The political and business community was confident that the license would be signed, if not with the Norwegians, then with Gazprom. “Kommersant<sup>216</sup>” wrote about this issue the next day, and since then I have had tense relations with this publisher.

I have to say that apart from the Norwegians, another “New Russian<sup>217</sup>” company, along with another American crook, was inquiring about the license. We faced them even before the agreement with Gazprom, when I was looking for money for funding. It was a typical raid staged down by rules, with articles not only in Kommersant, but also in the Wall Street Journal, where I was portrayed as a communist, and the raider was described as the future Rockefeller of Russia. I tried to appeal to E. Gaidar for protection, but he sided with the aggressors.

Suddenly I was helped by Charles Wick, the Reagan aide. I have already written about this fellow. Because of his work, he had access to relevant information about the raiders and gave the information to me. When the American came to me with a demand to transfer the license to his company, I told him that he had a different name, his

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<sup>216</sup> Kommersant is a commerce-oriented news publisher in Russia.

<sup>217</sup> “New Russian” is a stereotypical caricature term for the newly rich business class in post-Soviet Russia. According to the stereotype, New Russians achieved rapid wealth by using criminal methods during Russia’s chaotic transition to a market economy.

occupation was raiding, and that recently he ditched a company in California.

"I won the law suit!" American brazenly declared.

"If you had lost, I wouldn't be talking to you. And besides," I said, "what you are offering is illegal in America."

"Well, how about here?" he said.

I answered that our laws were not in good order yet, but a scam was still a scam, and I sent him away. They started to harass us, but I managed to hide the young Rosshelf behind the strong back of Gazprom. Infancy and the struggle for survival were over soon. The working life of the new company began.

First of all, it was necessary to organize the inner workings of the company itself and its relationship with Gazprom as its majority shareholder and investor. Vyakhirev recommended a director responsible for works on the shelf and in Gazprom. Organizationally it was the right decision, though personally he was worse than anyone I have ever worked with in various enterprises both in this country and abroad. We recruited Academician Sergei Nikitovich Kovalev, a remarkable scientist, engineer, and one of those who left an indelible mark on the history of Russia, as our chief designer. Many wonderful people came to the company, and some of them, for example with Vyacheslav Petrovich Kuznetsov, I hope to work with until my last days.

My amateurish search of Russian and foreign investors ended. This task was taken over by Vyakhirev. At first he tried to finance the project from the proceeds of Gazprom, but then he began to attract foreign companies.

Our partners subsequently were an English company, Hamilton Oil, Australian BHP, and the German Wintershall. As an engineering company we chose an English firm Brown and Root. This choice was very successful because they were not our competitors.

Sevmash had been upgraded and was able to produce not just boats and pipes, but also oil platforms. Production was saved, and the licenses remained in Russia at Gazprom. Four modules of a caisson platform for the Prirazlomnaya oil field, each sized 40 by 40 by 120 meters and weighing 40,000 tons, were built at the factory; they were assembled in the pool and welded to each other. The upper structure block was pulled over the caissons, and this entire Cyclopean structure was towed to Severodvinsk to the factory wall (where the equipment installation was completed) and then to the oil field in the Pechora Sea. This platform can produce up to 7 million tons of oil annually; when the oil prices are in the range of \$500 - \$600 per ton that amounts to \$3.5 billion per year. Not only Sevmash, but also the Kurchatov Institute, managed to survive the time of troubles.

In fact, we created the basis of the power-plant industry for the XXI century in Russia. The Tokomak, for example, could be assembled directly in shop number 58 of Sevmash and then could be towed to the place of its permanent location. The projects of the Prirazlomnoye and Stockman fields were built there; ITER's Tokomak could, technically and economically, have been successfully completed more than 10 years ago and could have generated a steady income by now.

Of course, these are large projects, on the scale of \$10 billion each. Who is to blame for the delays? It is very tempting to blame external circumstances, the Soviet command economy, or the chaos of the quasi-market time, the poor management that has been replaced many times, and all sorts of crises. Since I played a significant role in this process, then, of course my lack of competence and perseverance could be blamed as well. "Towards the hostile blizzard I went into the battlefield without the chain-mail."<sup>218</sup> But now it's time to follow the advice of Boris Pasternak:

Another, step by step, will follow  
The living imprint of your feet;  
But you yourself must not distinguish  
Your victory from your defeat.<sup>219</sup>

For ten years I was the President of the Rosshelf company, and those were very interesting years. Unfortunately, of this long epic not everything came out well. And many things again came back to square one...

The ITER project continued to evolve. But in 1989 the representation in Congress in the U.S. changed, and Jim Sensenbrenner, the chairman of the Commission of Science, announced that he would only support those international projects where U.S. dominance was guaranteed. The ITER project was built on equality, so the U.S. withdrew from it. The scientific community of the United States for economic reasons is very conformist and

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<sup>218</sup> From the poem "The Lord, preparing me to battle..." by A.K. Tolstoy, 1857.

<sup>219</sup> From the 1956 poem "It is not seemly to be famous...", Translated by Lydia Pasternak Slater.

manageable, therefore they supported this decision. They even reached the point when American scientists were forbidden to attend conferences, seminars and sessions where the issues of ITER were discussed. Even in the worst times the CPSU Central Committee did not behave like this. Our opponents believed that the project would fall apart. But we held out, though we reviewed the project in the direction of its price reduction. Together with a large volume of test works that were performed on the most modern equipment, including the defense equipment made in the U.S.A., Europe, Japan and Russia, the cost of the project reached \$2 billion.

When a new administration came to the White House, and the national energy policy was changed, the U.S. returned to the project. After them Korea, China and India came in, so that a large part of humanity became involved into the project. In a short time Canada joined us and offered its site, which was very important because it allowed us to start negotiations on the construction.

Under the leadership of Ken Tomabechi from Japan, we completed the conceptual part of the project. The transition to engineering and technical design was not without difficulties. I remember how our action team, Anna Davis (U.S.A.), Charles Maisonnier (Euratom), Masaji Yoshikawa (Japan) and I spoke in Bonn before the Bundestag commission. After listening to us, the representatives of the Christian Democratic Union of Germany said that they would support us if we could prove that the result would be an established real power source; the Social Democrats said they would support a purely scientific work, and the Green Party offered their own

crazy projects. But in the end, we found a compromise and were able to agree on everything.

In the U.S. we established good relations both with the administration and with Congress, and in Japan we were supported by the ruling party and its chairman, J. Fukuda. Even with Greenpeace then we had excellent business relationships, especially with its Director, General David McTaggart. But the project suddenly stalled. All parties, except Russia, which at that time was not financially sustainable, agreed to proceed with the design only on the condition that the organization should be placed in their territory.

In Europe during this period Klaus Pinkau, the Director of the Institute of Plasma Physics of the Max Planck Society, had great influence. With him we looked for different options out of the situation, and came to the idea of a distributed center. We proposed to host the Integral Center in San Diego (La Jolla, California), the designing of the inner parts, including the Tokamak, in Garching (Germany), and development of the external system, including the magnetic setup, in Naka (Japan). In Moscow we wanted to accommodate the Council itself, and in St. Petersburg the Center of engineering and design support, on the basis of the D.V. Efremov Research Institute of Electro-physical Apparatus. All organizations were expected to be linked by a system of electronic communication, and all design was to be done in electronic form only. Back then this kind of a proposal was revolutionary. The internet did not exist yet, and we were heavily criticized. But ultimately this form has proven to be very successful, providing operation around the clock and a



close relationship with the national teams. I was elected as the Chairman of the ITER Council, Professor Paul Rebut was Project Director, and Masaji Yoshikawa was my deputy. In the future Paul Rebut was replaced by Robert Aymar (France), and in this format, we successfully completed a working draft in 1998.

After 20 years of planning and negotiations, in 2006 an unprecedented international agreement on the construction of ITER in Cadarache, France, was signed at the Elysee Palace in Paris. The meeting was chaired by French President Jacques Chirac, the only political figure remaining of those who started the project 20 years ago. It appears that this decision is already irreversible, and the ITER project will be the first example of global cooperation in addressing a critical problem of our civilization, providing mankind with energy. In fact, the ignition of the plant's thermonuclear reaction on Earth, the same reaction that fuels the sun and stars, will be the final triumph of the idea of Prometheus to bring the fire of the gods to mankind. I hope to see this moment, if my health allows it. Prometheus, as we know, had problems with his health too.

Thus, an international organization was created. Our success is owed to strong support from Vladimir Putin, then the President of Russia. In the U.S. we were actively supported by the ex-governor of Alaska W. Hickel, by the assistant vice president, Charles Lundquist, and by the former U.S. Deputy Secretary of Energy, R. Orbach. We owe much to parliamentarians in Japan, headed by K. Mori, and to the Prime Minister Junichiro Koizumi. The project is progressing, albeit not without difficulties. But today this is

the largest project both by scale and by composition of participants, which gives an indication of how prepared the international community is to jointly meet the challenges of this level. I was again elected as the chairman of the ITER Council, the governing body of the project.

For 10 years I was closely attached to La Jolla, a wonderful area of San Diego in southern California. Natalia dearly loved this place and dreams of coming back, temporarily, of course, for that's how we lived there then. Our younger son Pavel graduated from the University of California at San Diego, with a major in Computer Science (unfortunately, we still have no analogue of this specialty in Russia). The center for ITER, the university and small-town motel-style dormitory where my wife and I usually stayed, were located near the university shopping mall, so everything was close by and very convenient. The apartment was located on the first floor, and skunks, opossums, squirrels and racoons often came onto the balcony. The beach and the endless Pacific Ocean were nearby. Americans did not generally swim there, just surfed, because the water was cold. Summer temperatures in this place differ from the winter ones by about 5 degrees, but the locals prefer to swim in warm pools or in outdoor Jacuzzis. The desert and the mountains were nearby. Pavel was engaged in rock climbing, and we as a family went skiing together. San Diego has a wonderful zoo and a lovely outdoor center of marine life with an aquarium and dolphins. And there was Lake Tahoe within a day's drive, with its fantastic sunsets, and with its world-renowned ski

resort Squaw Valley (remember the movie "Sun Valley Serenade"). On our skiing holidays, we stayed in California, and went out to dinner in the neighboring state of Nevada, where in the casinos the same great New York steak was twice as cheap. Once, on the pass, there was such a breeze that Natalia could not ski downhill. Sitting in a warm cafe on the mountain and drinking beer, we sympathized with the pioneers, who at that time of the year traveled to California through the Squaw Valley.

Pavel had difficult relations with American cars. Once he forgot to add oil to his first cheap Ford we had bought him. When he saw the estimate from the service station, he decided to leave the car there permanently. But when he moved from the student dorms and we rented him a room, in the parking lot we saw with a little surprise that same "Tin Lizzie". We had to buy him a new car, a small jeep, which Pavel drove with our daughter's husband from New York to San Diego. Once Pavel left all his documents in a motel in a small town with the strange name Pueblo and noticed only when he got to San Francisco. But in America usually this is not a problem: he quickly received the documents by mail, including the money. On a different occasion, Pavel drove Natalia to the airport, and since they were in a hurry, she accidentally put her wallet on the roof of a taxi, which drove away. A few days later the wallet with the money was sent to Pavel's apartment, even though the wallet had no information about Pavel. So I think the FBI did a good job. We felt sorry to leave California. In San Diego a lot of our friends remain: at the university, at the Supercomputer Center, at the General Atomics Company, and also at a very peculiar, purely scientific

private corporation called Science Applications, shares of which belong only to its employees.

At the beginning of the troubled times I'd been pretty active in trying to save and modernize the major defense industries: nuclear and space. Together with leading scientists, we organized a meeting with Boris Yeltsin, who authorized the transition of Sredmash to the jurisdiction of the Russian Federation. Yeltsin appointed V.N. Mikhailov, a scientist from Arzamas, as the Minister of Atomic Energy. We gathered after this appointment in my sauna in Zhukovka, and toasted the occasion.

At this stage the main tasks of the industry were the following: modernization of nuclear power plants, primarily Chernobyl-type reactors, in terms of safety of operation, establishing an order for the recording and storage of nuclear materials during the disintegration of the state and the KGB, developing equitable relations with our former chief opponent the U.S. and with the West in general, and ensuring the protection of our own economic interests. On one issue, the non-proliferation of nuclear technology, materials, knowledge and expertise, our interests coincided with those of the West, and we have achieved a lot together. With regard to commercial competition, our interests were opposite, and our competitors have tried to push our nuclear power industry from everywhere they could. But the nuclear industry of the West had, and still has, its own problems. As a result, the so-called “nuclear renaissance” began due to a large extent by the initiative of Vladimir Putin, from his speech at the

UN in 2000 and at the St. Petersburg Summit in 2005. It became obvious that a solution to economic and environmental problems, including global warming, is impossible without a serious expansion of nuclear energy, which should be exercised only by the joint efforts of key countries, as exemplified by the ITER project.

In the spring of 1992, I accompanied Boris Yeltsin during his visit to the United States and meeting with Bush senior at Camp David. It was a stunning spring in our relations with America. Yeltsin's speeches to the UN and to Congress were accompanied by standing ovations. It seemed that the cold war had melted away forever, and in the future we would together, hand in hand, build a new world of democracy, freedom and prosperity, and jointly build defenses against potential aggressors and terrorists, including missile defense. In such high spirits, we went by helicopter to Camp David.

In Washington, I participated (unofficially) in the preparation of the so-called "Freedom Support Act", where I lobbied for the support of our youth organizations, primarily for Junior Achievement. Then we came up with an idea: why not support the participation of Russia in the international space station project? I asked my colleagues to prepare a statement from Yeltsin to Bush, and they brought it to me straight to the helicopter. It was written in English. During the trip I told this idea to Yeltsin, and he supported it. He did not sign the letter, just gave it to George Bush and expressed his support. Bush, in turn,

handed the letter to B. Scowcroft, and formal negotiations began.

In Moscow, Boris Yeltsin called a meeting to organize the space agency, and it was created under the direction of Y.N. Koptev. So, among other things, I have been involved in the creation of the Russian Space Agency, and the ISS.

Soon, however, Bush lost the election. Bill Clinton was elected as the U.S. President, and Al Gore as the Vice President. The Gore-Chernomyrdin Commission started its work. The Democrats came to the Pentagon. William Perry of Stanford became the U.S. Secretary of Defense. I remember once I was late to my appointment with him, and I came to the Pentagon straight from the airport with my suitcase. I tried to leave it with the guard, but the guard said "Take it with you and just go right along the corridor." So, with a suitcase, I walked around the entire Pentagon. Either before or after, and I think even now, with Barack Obama, it would be simply unthinkable. In Russia, Andrei Kokoshin became a Deputy of the Defense Minister P. Grachev. With Kokoshin we were on the same team in Gorbachev's time. It seemed to me this would open the road to a radical change in relations...

As I wrote already, my political sympathies were with the Liberals. This was affected by my family upbringing, and by the new literature that became available at the time. In Boris Yeltsin's fight against the Parliament and the Communists, I was clearly on Yeltsin's side. At this time, the President set up various commissions, and Savva Kulish, together with S.N. Krasavchenko, drew me into the Commission on the Arts and Culture. There I made friends

with wonderful people, such as B. Messerer<sup>220</sup> and B. Akhmadulina<sup>221</sup>, as well as their friends, and began to help them in their noble work. The Commission participated in election campaigns and achieved some important results, for example, we organized the television channel "Culture". A Commission on Science also formed but, because of certain circumstances, quickly ceased its operation.

At this time, Kokoshin organized the Defense Council and invited me to work there. I received an office across from the Kremlin and gained some influence, which I used mainly to support and diversify the defense industry. I was, however, in complete conflict with the new Russian liberals. One of my few successes was my support of V.B. Betelin, who proposed to establish a clustered plant for production of microprocessors and large-scale integrated circuits for the purposes of science and industry. First, he found the right financial scheme, and secondly he set up a correct organizational model. The factory was designed, assembled and launched in Switzerland, and then it was insured and transported to Russia. In our country, under the existing customs rules, it would be unthinkable to build such a factory. The factory was set up at the Kurchatov Institute. After all these years, it has successfully operated and remains the only plant in Russia that produces modern microprocessors. But to this day there are attempts to privatize it, or as an extreme, to close it completely. It is not an impossible outcome; for example, Yeltsin closed the

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<sup>220</sup> Boris Messerer is a Russian theatrical artist, member of the Academy of Fine Arts.

<sup>221</sup> Bella Akhmadulina was a Soviet and Russian poet, short story writer and translator known for her apolitical writing stance.

Defense Council (in my opinion, it was a mistake, because the Council played a useful role).

In international affairs, significant progress was made. First of all, we managed to consolidate all the Soviet nuclear weapons to Russia, and to prevent substantial leakage of specialists in nuclear materials and technologies. It was assisted largely by the new International Science and Technology Center that was created at the aforementioned Camp David meeting. Cooperation to create a culture of safety at Russian nuclear power plants was also successful. V.S. Mikhailov established a very unique relationship with Hazel O'Leary, the U.S. Secretary of Energy. Together with her, we tried to stop the production of plutonium, compensating for the loss of power by constructing 4 gas turbine stations in Tomsk. We were supported by Frank von Hippel, who briefly appeared in the White House as an advisor for Science to the President. Unfortunately, the local elite in Tomsk found common interests with the Americans and instead chose the coal option. It did not work out, but the turbine project already endorsed by Gazprom was ruined. And only now in the Presidential program of modernization are we coming back to the construction of gas turbine power plants, with almost two decades of delay. By the way, we made the first attempt to adopt the relevant legislation by following the example of the U.S. And again, only recently has it become a success.



In the same years at the Kurchatov Institute, we developed together with Mosenergo<sup>222</sup> a company for the construction of a gas turbine power plant based on combined cycle technology. We started this project on the grounds of the Institute, in collaboration with my friend Norman Svonsen, with whom we previously carried out the youth exchange program "People to People". He enthusiastically took up the deal and lost half a million dollars and a couple of years. Unfortunately we were not able to satisfy two mandatory conditions, a long-term contract for the supply of gas from Mosgaz<sup>223</sup> and a contract with Mosenergo to purchase electricity. Today, those same problems are again on the agenda, and the Commission on the modernization program of energy conservation is planning to deal with these problems.

Norman was a heavy drinker, starting each morning with a beer, for which our children nicknamed him a "drunk unrestrained." In order to wean him from this bad habit, I brought him to our village Talitsy and trained him to freshen the nip in the morning using ant alcohol, in the same way the bears do. The bears are known to lick their paws and to put them in an anthill with big red ants. Then the paw is quickly withdrawn, and the bear licks and sucks the spirit out of the ants before they have time to sting his tongue. In addition, in the spring, frozen cranberries from the year before are very good for fighting hangovers. In general, many of my American friends became acquainted with the Russian hinterland in Talitsy. Al Trivelpiece, who

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<sup>222</sup> Mosenergo (from "Moscow Energy") is Russia's largest power generating company operating on fossil fuel and the world largest thermal generation company.

<sup>223</sup> Mosgaz (from "Moscow Gas") is the natural gas supply company in Moscow.

began the U.S. DOE Human Genome Project, once gave a lecture there at the A.K. Ailamazyan Institute for Software Systems. Joel Cunningham, the President of the Susquehanna University in Pennsylvania and his family learned to gather mushrooms here. Tom Dillon, a vice-president of the Science Applications company from San Diego, and his wife visited the local museum of steam locomotives, and we drove him on the rail trolley through the burning forest. Businessman Sema Gandler from New York fished here and conducted unsuccessful negotiations with local entrepreneurs.

Once I brought the mayor of the famous city of Ariel, Israel, here, and we began to cooperate on the use of wireless Internet in school education. We drove with him in a Volkswagen bus with a broken engine, and the exhaust gas got inside the cabin and we nearly suffocated on the road. Given the bitter experience of the German gas vans, it could have resulted in a major international scandal, if not for our good relations and the healthy sense of humor of my Jewish guest. He, in turn, under the program of civil cooperation, invited a local surgeon and our great friend to Ariel.

Once I was visited by another friend, David Hamburg, a great scientist and president of the Carnegie Corporation. We developed a joint project of pioneering the use of emerging information technologies to link New York and Moscow schoolchildren, the so-called "Project Velham"<sup>224</sup>. On our side, it was led by Professor E. Belyaeva of the Institute of Psychology RAS, and on the American side by Professor P. Cohen, a big fan of L.S. Vygotsky and A.R.

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<sup>224</sup> The project "Velham" name is an abbreviation from "Velikhov" and "Hamburg".

Luria, the great Russian psychologists, and the founders of cognitive science. I wanted to acquaint him with A.K. Aylamazyan and at the same time to show him my village. On the road, our "Volga" got stuck, as it often did, in a puddle of mud. David asked "What do we do?" I looked at him and said "What do we do? Take off your pants. We will push the car out of the puddle." This adventure brought us even closer together.

Continuing the theme of communicative interaction on the basis of information technologies, I want to go back to Soviet times. We had a friend Misha Goldin, a big fan of mass actions, which he had been always trying to organize. Because of this, a lot of trouble happened to him, and I constantly had to pull him out of these troubles, including a psychiatric hospital. He was a great enthusiast for mass videoconferences with large screens. One day in 1983, he managed to organize the first mass television bridge "Moscow - Los Angeles"; the host was V. Posner<sup>225</sup>. In Moscow, people gathered in Ostankino<sup>226</sup>, and in Los Angeles at a stadium. One of the sponsors of the event was Steve Wozniak, who along with Steve Jobs created the first personal computer in his garage. The political sponsor was Congressman George Brown of California. We were supported by the Fund for Peace, so the theme was pretty standard. But one episode really shocked me. I came to the podium and I started talking about the dangers of nuclear

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<sup>225</sup> Vladimir Posner is a Russian journalist best known in the West for appearing on television to represent and explain the views of the Soviet Union during post Cold War times.

<sup>226</sup> Ostankino is the home of the main television studios in Moscow.

war. Purely intuitively I uttered a phrase, "Nuclear weapons are not muscles, they are the metastases of a cancer", and suddenly the 200,000 Americans in the stadium stood up and applauded! It was one of the most significant moments in my life, and a totally unexpected one...

Later, with the support of George Brown, we tried to arrange teleconferences with the participation of the Russian Supreme Council and the U.S. Congress. There were temporary successes, but the program did not become systematic. The next program was initiated between Tufts University and the Mendeleev University of Chemical Technology in Moscow, and student teleconferences were held continuously for some time.

The most memorable moment for me was the invitation of Academician Y.B. Khariton to the teleconference. He was still a very "secret" person then, and appeared on the open teleconference for the first time. Americans asked him about when he started working with chain reactions. "In 1926" said Khariton. I'm not sure that the American audience understood the significance of this response. Officially, a nuclear chain reaction was first achieved only in 1942 by Enrico Fermi in Chicago. Subsequently, this teleconference contributed to the beginning of the declassification of the Soviet uranium project, in which so much contribution was made by veterans of the Russian nuclear industry, Lev Ryabev, David Hollway, and Yurii Gaponov of the Kurchatov Institute and many other Russian scientists.

Technology continued to evolve. iChat emerged. Many times I tried to establish a teledialog with someone, looking eye to eye. Science has proven that only such

contact activates the frontal lobes of the brain and involves the intellect to its full potential. In the Civic Chamber of its first convocation, Mikhail V. Ostrovsky found sponsors, and each member of the Chamber received an Apple laptop with a camera. All were trained to work with these laptops, but not much came out of this. Throughout the world, I have only three or four reliable interlocutors. In the U.S. and Japan such contact is almost banned for government employees, as well as in corporations. Now everybody, even my 10-years old grandchildren, use Skype, and I hope Apple will succeed with FaceTime and Clouds. But still the main problem is the inertia of common minds.

In recent times I would like to mention a few events. Firstly, I think I made a good decision to invite Mikhail V. Kovalchuk, first as director of the Kurchatov Center for Synchrotron Radiation and Nanotechnology, and then to appoint him as the director of the Kurchatov Institute. I have long tried to convince our employees that we need to complete the source of synchrotron radiation. The decisive step in this direction was made by A.P. Aleksandrov, when he was the President of the Academy of Sciences and the director of the Institute. He made a deal with the Institute of Nuclear Physics, and in particular with Academician A.N. Skrinsky, on construction of the accelerator and storage ring at the Kurchatov Institute, and it was accomplished. But a similar ring was under construction in Zelenograd, and the resources needed to build the infrastructure, and provide the adequate scientific level needed for using the accelerator, somehow were split between the two projects.

In the Ministry of Science, we stood in a position of Buridan's ass. One could, of course, try to resolve the issue forcefully, but I never considered this method effective and decided to invite to the Kurchatov Institute my old acquaintance, M.V. Kovalchuk, who was then the Director of the Institute of Crystallography of the Academy. He was highly regarded by Academician B.K. Vainshtein, his predecessor at the Institute of Crystallography, and by A.P. Aleksandrov.

Kovalchuk destroyed the provincial spirit that prevailed in our Institute, and elevated the Center to the international level. At the same time, he formulated a national program of nanotechnology and became its scientific leader, thus opening a new breath for the activities of the Institute. Admittedly, it occurred much later than in America, where a similar program started 7 years earlier. Nevertheless, for the first time in Russian and Soviet history the development of a program had sufficient resources suitable for a full-fledged national project.

Kovalchuk conceived and implemented yet another great idea: the establishment of the four key technologies of the XXI century, Bio, Nano, Information and Cognitive, both at the Kurchatov Institute and at the Moscow FizTech<sup>227</sup>. He reformed the Academy Branch of Information Technologies in the same direction. In this case, the Institute rose to a new level in areas such as nuclear science and industry, the development of nuclear fusion research in Russia, the realization of the ITER project in the world, the development of basic research in areas such as quark-gluon states of matter with

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<sup>227</sup> FizTech is the Moscow University of Physics and Technology.

temperatures of several billion degrees (to measure that we had created the proper technique of neutrino studies), research in the field of weak interactions, astrophysics, medicine, physics, condensed matter and laser physics, plasma chemistry, and supported developments in the field of superconductivity and isotope separation technology. All these programs are supported via agreements with leading centers for scientific and technological cooperation and joint development, and use of major experimental facilities and complexes. As a result of the decrees of Vladimir Putin and Dmitry Medvedev, Kurchatov Center was designated, together with the nuclear institutions of RAS and Rosatom, as a pilot of a new type of National Research Center.

An essential part of my life was the Civic Chamber of the Russian Federation. I was not involved in formulating the idea of creating the Chamber, but I was invited by Vladimir Putin to the Chamber at the stage of its creation. Dmitry Medvedev offered me the position of a Secretary of the Chamber, we discussed the scope of my duties, taking into account the existing ones, and I agreed. On one hand, I have always felt a responsibility to my grandparents, who sacrificed their lives for the fulfillment of civic duty. On the other hand, I had quite extensive experience in civil activities, both through arms limitation and in the field of extracurricular education of school students, about which I wrote, as well as through my prolonged activity in the Presidential Council. Work at the Foundation for the Survival and Development of Mankind has allowed me to get international experience in the functioning of non-

governmental organizations. The very idea of an NGO as a network type, non-hierarchical and voluntary, uniting absolutely equal and independent citizens on the basis of the idea of service to society, always impressed me. It is for these reasons that I gave my consent.

I completed the third term of my work as Secretary of the Civic Chamber, so we can draw some conclusions. I will not talk about the principles of the functioning of the Chamber itself, it's easy to find the description on the site [opr.f.ru](http://opr.f.ru), but above all I want to note the following features that distinguish the Chamber from similar organizations in Russia, as well as abroad. First of all, despite the principle of the member's election, the members of the Civic Chamber do not represent anyone but themselves as individuals. They are prohibited from participating in political organizations, they do not receive any salary or any other material benefit, they are not guaranteed to have support from the media and press, they do not have any government preferences, and they have no special legal status or immunity. Of course, the society pays attention to them and a certain public profile is being built, but in general, this is an example of pure altruism. Their duties are imposed on them by law; this includes an annual report on the state of civil society, participation in the Public Councils under various government departments, involvement in the examination of laws and regulations, work in various committees, and much more. Society expressly confers on members of the Chamber a responsibility for the political, economic, and moral condition of the country in various spheres, from domestic to global. People pay attention to the Civic Chamber, strive



to be included into it, and similar chambers appear both in the regions, and even at the municipal level.

I do not want to idealize the Chamber, but at the same time I would like to draw attention to its unique properties that are alien to our pragmatic, cruel and cynical age, which we criticize so often and so rightly. Work in the Chamber enabled me to get acquainted, first, with many remarkable Russian public figures, which Russia has aplenty, and second, with the real problems of the society, starting from the ground up, especially at the municipal level where the citizen faces the power of officials and money. The Constitution gives full power to the citizen, but all the previous constitutions declared that as well. However, a joke about a conversation between a commoner and a lawyer is still valid

The commoner asks: "Do I have a right to...?"

The lawyer, without waiting for the end of the question, answered firmly, "Yes, you do."

The commoner replies "And can I...?"

"No, you can't."

We live in a confused time in Russia, in a hellish mixture of wild capitalism and the remnants of serfdom and the socialist utopia. The authorities, still largely united with criminal money at the municipal level, seize public property and fiercely guard it both from the state and from the citizens. I think that the mission of the Civic Chamber, in collaboration with the legislative, executive and judiciary powers, consists of the liberation of society from those traps. This is a lengthy process, as is shown by the experiences of many countries; it requires perseverance, patience and a certain cultural level of both the authorities

and the citizens. The other concerns of society are built on this foundation: physical and mental health, education and science, safety and welfare, lifestyle changes (openness), the transition from the dictate of television to the Internet, demographics, parent-children-grandchildren relationships, globalization and xenophobia, and the resolution of conflicts between labor and capital. The members of the Chamber are involved in the discussion on these issues. The Civic Chamber as a form of civil society grows in breadth, into the regions, and into the interior, being converted into a form of self-organization. We naturally became included in the international association of public houses and similar social organizations. I think that along with the UN, such horizontal association, independent of the authorities, is gradually gaining weight. Let's hope that humanity will live safely with dignity on this planet.

As for the history of civil society in Russia, besides the well-known events, when civil society has played a historic role (for example, the militia led by Minin and Pozharsky<sup>228</sup>; popular Veche in Novgorod<sup>229</sup> and others), we must turn to lesser-known facts such as the creation by Catherine the Great of a Commission for the preparation of a Legal Code in 1767 (mentioned earlier in this book in connection with the name of the commission headed by Alexander Bibikov), that was working by special decree of the Empress. The principles of election to the commission were very interesting. The elections covered all social classes and in fact were close to the principles of election in

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<sup>228</sup> Prince Dmitry Pozharsky and merchant Kuzma Minin gathered an all-Russian volunteer army and expelled the Poles from Moscow, thus putting an end to the Time of Troubles in 1612.

<sup>229</sup> The Veche was the popular assembly, the highest legislature and judicial authority in the Republic of Novgorod until 1478.

the highly influential Social and Economic Council of France. The only difference was that Bibikov's Commission was created 200 years earlier! Soviet historians wrote that the Commission held 200 meetings in which it spoke frankly about all the problems of Russian society, including serfdom. An interesting fact is that during the meetings the Empress sat behind a screen, listening and making appropriate conclusions. So the relationship with the supreme authority of the Empire was the most direct. How was all this reflected in the early work of Alexander I<sup>230</sup>, the lawmaking of M.M. Speranskii<sup>231</sup>, the constitutions of the Decembrists<sup>232</sup> and the fate of Russia? I'd really like to trace this world line of Russian history, but I'm afraid I will not have enough skill or the time limit that is allotted to me by fate.

We live as in an unfathomed dream,  
On a most convenient planet...  
There are many things, of which we have no need,  
Yet nothing which we truly desire...  
Igor Severyanin, 1909

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<sup>230</sup> Alexander I of Russia served as Emperor of Russia from 1801 to 1825. In the first half of his reign Alexander tried to introduce liberal reforms.

<sup>231</sup> Speransky Mikhail Mikhailovich (1772-1839) was the Secretary of the State Council and the closest adviser of Emperor Alexander I in his reform efforts.

<sup>232</sup> The Decembrist revolt took place in Saint Petersburg on 14 December, 1825. Liberal-minded army officers led about 3,000 soldiers in protest against Nicholas I's assumption of the throne.



Pavel Apollonovich Velikhov  
(grandfather)



Evgenija Aleksandrovna Evreinova  
(grandmother)



Vera Aleksandrovna and  
Pavel Apollonovich Velikhov  
(grandmother and grandfather)



**ВЕЛИХОВЪ,**  
**ЛЕВЪ АЛЕКСАНДРОВИЧЪ.**

Lev Aleksandrovich Velikhov  
(Grandfather's cousin) — well-  
known public figure, member of  
the Central Committee of the  
Cadet (Constitutional Democratic)  
Party and the State Duma, a Com-  
missar of the Provisional Government



Natasha [Natalia] Evreinova  
(mother)



Evgeny Pavlovich (uncle)  
and Pavel Pavlovich  
Velikhov (father)



Natalia Vsevolodovna  
Velikhova (mother)



Pavel Pavlovich Velikhov  
(father)



Father and Mother on vacation  
in Crimea (end of the 1930s)



Evgeny Pavlovich Velikhov  
(uncle) and Elena Gogoleva  
in the play "Glass of Water"





Zhenia [Evgeny] Velikhov  
(1935)



Zhenia [Evgeny] Velikhov  
(1937)



Near the house on Losinoostrovskaja station (1938)



Evgeny Velikhov (right) with his brother Vladimir (1946)



Evgeny Velikhov - Student of  
School No. 588 in Moscow  
(1950)



Evgeny Velikhov - Early  
years at the university





Evgeny Velikhov with his friend Zhenia Yurgenson



Nikolai Bambidi



School No. 588 in Moscow, 9th grade



Expedition to sub-Arctic Ural region, Kokpela River, 1954



Expedition to sub-Arctic Ural region, 1954



Expedition - E. Velikhov (center) builds a raft for travel  
down the Sosva River



Newlyweds Evgeny Pavlovich and Natalia  
Alekseevna Velikhov, 1959



Evgeny Pavlovich, Natalia Alekseevna, and Vasily (son) Velikhov with their pets Enik (the dog) and Jakov Borisovich (the monkey)



Jakov Borisovich



Enik



Evgeny Pavlovich with daughter Natasha  
at the village of Talitsy



Fans — E.P. Velikhov with his wife and their son, Pavel



The first lessons on the computer for daughter Natasha and son Pavel



Family team at the start of the ski race



Erecting a memorial sign near  
Pereslavl-Zalesski



E.P. Velikhov and Metropolitan Pitirim open  
the first Russian-American Youth Camp  
at Pereslavl-Zalessky



An Academician and a carpenter



At the summer village in the village of Talitsy





Evgeny and Natalia on a mushroom hunt



This guy will not fail



En route to the summer cottage in the village of Talitsy



Oh, it's hard work - to drag from the marsh...



Swimming in the ice hole (Talitsy)



On the mountain top



Pavel Velikhov in Cupertino, California  
with John Sculley, the CEO of Apple Computers



Natalia Alekseevna, Evgeny Pavlovich and Pavel Velikhov  
at Savannah State University (USA)



Evgeny (grandson)

Zhenia (Evgeny's grandson)  
and Natasha (daughter) with  
Valentina Tereshkova and  
Nikolayev at the Star City



Elizaveta, Ekaterina  
and Amelia  
(granddaughters)



Vera Nikolaevna Zagorianskaia (Aunt Vera) with  
her son Vladimir Pavlovich Velikhov  
(brother of Evgeny Velikhov)



Evgeny Pavlovich and Natalia Alekseevna Velikhov  
and their children and grandchildren



Chairman of the Council of Young Scientists of the Komsomol (presentation at the XVIII Congress of the Komsomol, 1978)



XVIII Congress of the Komsomol. E.P. Velikhov - fifth from the right in the fourth row



At the Pakhra branch of the Kurchatov Institute of Atomic Energy E.P. Velikhov engaged in science and in construction (1960's)



A meeting in the Kurchatov Institute of Atomic Energy on the occasion of launch of the world's largest thermonuclear Tokamak T-10 (June 30, 1975). From left to right: Academicians I.K. Kikoin, A.P. Aleksandrov, a representative of the construction organization - head of the division of the Minsredmash USSR A.A. Vasiliev, Academicians E.P. Velikhov, B.B. Kadomtsev





IAEA Director General Hans Blix on the Tokamak T-10 (1978). Left to right: B.B. Kadomtsev, E.P. Velikhov, Mr. Blix, N.N. Semashko, G.A. Eliseev



Walter Scheel, President of Germany, in the experimental hall of Tokamak T-10



At a memorial display of Academician L.A. Artsimovich



At the Institute of Nuclear Physics (Novosibirsk), visiting Academician G.I Budker (1968)



The USSR and the U.S.A. leaders of national Programs of Controlled Thermonuclear Fusion E.P. Velikhov and Robert Hirsch sign a protocol on the Soviet - American technical cooperation in the field of thermonuclear energy (U.S.A., 1974)



The participants of the meeting of the Soviet-American Coordination Commission on Fusion Energy (SACCFE) in Princeton (U.S.A., 1976). In the center: the co-chairs the commission, E.P. Velikhov and Robert Hirsch.



Meeting of the SACCFE at the Kurchatov Institute. Far left - the U.S.A. co-chairman E. Kintner, far right - the USSR co-chairman E.P. Velikhov



The delegation of U.S. senators visit Tokamak T-10 (1979)



Leaders of national fusion programs. From left to right: B. Pease (UK), B.B. Kadomtsev, T. Ohkawa (USA), E.P. Velikhov, G. Grieger (FRG), D.D. Ryutov (Moscow 1981)



The first secretary of the Moscow City Committee of the CPSU Boris Yeltsin in the experimental hall of the Tokamak T-10 (1987)



Participants of the 12th meeting of the ITER Council (Tampere, Finland, 1997). In the center - future winners of the International Prize "Global Energy" for 2006, Robert Aymar, Masaji Yoshikawa and E.P. Velikhov



Speech by IAEA Director General Mohamed El Baradei at a meeting of the ITER Council. To his left the chairman of the ITER Council, E.P. Velikhov, to the right - the co-chair of the ITER Council M. Yoshikawa (Vienna, Austria, 2001)



E.P. Velikhov and Professor K. Pinkau (Nuclear Centre Jülich, Germany)



E.P. Velikhov and Professor A. Trivelpiece (Oak Ridge National Laboratory, USA). Moscow, 2005



Academicians E.P. Velikhov and R.Z. Sagdeev (University of Maryland, USA). Moscow, 2005

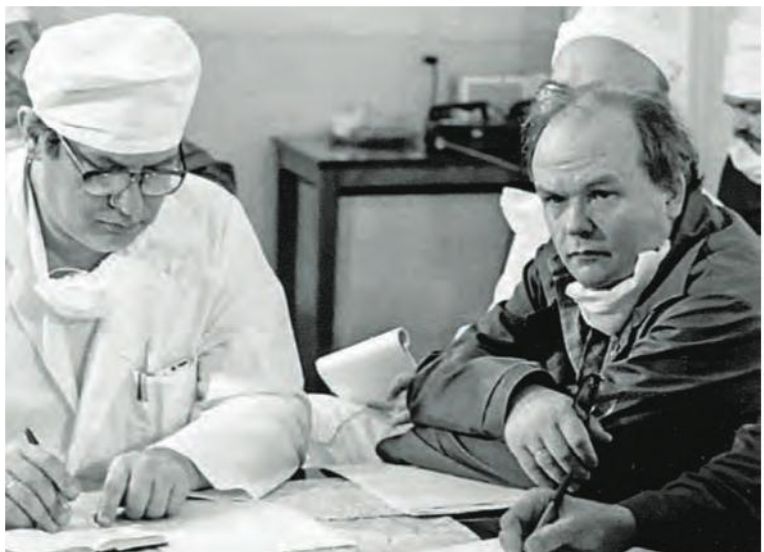


E.P. Velikhov and Susan Eisenhower (granddaughter of U.S. President D. Eisenhower)





Chernobyl (1986)



Briefing at Chernobyl Nuclear Power Plant (June 1986)



At the display of the Russian Scientific Centre "Kurchatov Institute" during the exhibition of defense industry, U.S.A.

From left to right: Congressman C. Weldon, E.P.

Velikhov, director of NASA A. Goldman (Philadelphia, 1999)



E.P. Velikhov and M.V. Kovalchuk –  
leaders of the Russian Scientific Centre  
"Kurchatov Institute" (2006)



Participants of the meeting of the Russian Board of Directors of the INPRO (the International Project on Innovative Nuclear Reactors) with the directors of the American national nuclear laboratories. IAEA (Vienna, 2004). In the center: E.P. Velikhov; P. Robinson, president of Sandia National Laboratory; Yu.A. Sokolov, IAEA Deputy Director General



Academics V.B. Betelin and E.P. Velikhov attending information technology exhibition at the Russian Scientific Centre "Kurchatov Institute" (April 24, 2006)



At the opening ceremony of the network GLORIAD. Greg Cole (executive director of the project GLORIAD in the U.S.), Yang Bo Ping (Director, Center for networks, computer science and informatics of the Chinese Academy of Sciences), E.P. Velikhov



Meeting of the International Public Foundation for the Survival and Development of Mankind. Left to right: A.D. Sakharov, EP Velikhov, R. Bjornested (Executive Director of the Foundation)

With Edward Teller  
in Dubna



At the ceremony of launching the superbloc base of the  
offshore ice-resistant oil platform "Prirazlomnaya"  
(Severodvinsk, Sevmash, June 2005)



Head of the Joint Chiefs of Staff U.S. Admiral William Crowe, U.S. Ambassador to Russia Jack Matlock, E.P. Velikhov



There will be Research Center in Shatura! Sitting from left to right: E.P. Velikhov, V.I. Konotop (First Secretary of the Moscow Region Party Committee), A.P. Aleksandrov



A visit to Frank Press, the science advisor to President Jimmy Carter



Audience with Pope John Paul II



Metropolitan Philaret and E.P. Velikhov



Visiting the Dalai Lama





A meeting of Mikhail Gorbachev with the international public organization "Junior Achievement"



Margaret Thatcher, Valentina Tereshkova, and E.P. Velikhov



Meeting with Ronald Reagan (on the right - Pavel Velikhov)



Ju.S. Osipov, E.P. and N.A. Velikhov, Ju.P. Lubimov, L.D. Rejman at the House of Scientists (Moscow, 2005)



Chingiz Aitmatov and E.P. Velikhov



Meeting with Nobel Prize winner, poet Gabriel García  
Márquez



E.P. and N.A. Velikhov with Adriano Celentano in Zurab Tsereteli's workshop



With Dada family at their home on the Grand Canal in Venice (on the left: A. Gromyko)



Father Eligio with Natalia Alekseevna and Natasha Velikhov (Sicily)



At the Vatican. The Napoleon's crown-tiara made of papier-mâché



E.P. Velikhov and the chairman of the Industry, Transport and Communications Commission of the State Duma of the Russian Federation V.A. Yazev



Visit of Prime Minister Junichiro Koizumi to Russian Scientific Centre "Kurchatov Institute" (January 11, 2003)



John Holdren, advisor to President Barack Obama for Science and Technology, and the heads of Russian Scientific Centre "Kurchatov Institute" E.P. Velikhov, and M.V. Kovalchuk



Visit of Russian President Vladimir Putin to the Russian Scientific Centre "Kurchatov Institute" (April 18, 2007)

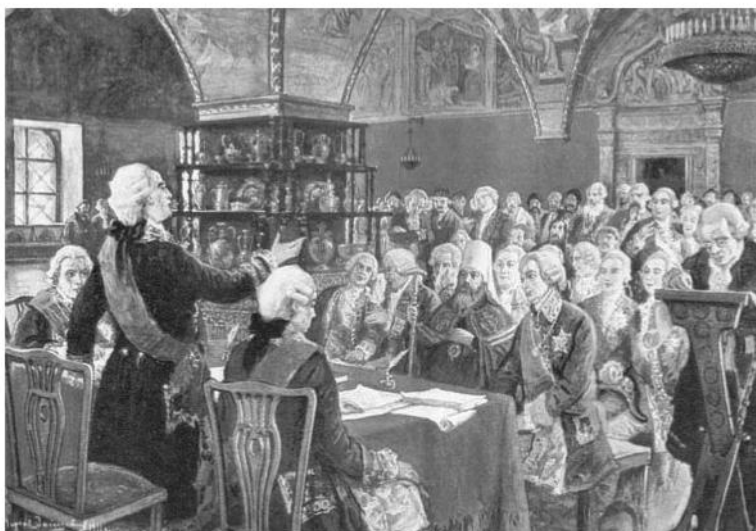


Global Energy Award winners for 2006: M. Yoshikawa, R. Aymar, E.P. Velikhov. The award was given for the development of scientific and technical bases for the International Thermonuclear Reactor project (ITER)



Russian President Vladimir Putin hands over the Global Energy Award for 2006 to E.P. Velikhov





Alexander I. Bibikov leading the Commission for the preparation of a Legal Code, 1767



At the Council meeting of the Civic Chamber. From left to right: A.G. Kucherena, S.N. Katyrin, E.P. Velikhov, and V.A. Nikonov (January 2006)



Consortium for Electromagnetic Probing. In the center –  
E.P. Velikhov and M.S. Zhdanov  
(Salt Lake City, Utah, 2008)



Master Class on Nuclear Technology (International Youth  
Forum, St. Petersburg, 2009)



E.P. Velikhov and First Deputy Prime Minister Dmitry Medvedev at the opening of the Second All-Russian Civic Forum (Moscow, Manege, January 22, 2008)



Visit of Russian President Dmitry Medvedev to the Russian Scientific Centre "Kurchatov Institute" (September 30, 2009)